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GEOLOGICAL SURVEY

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OF ALABAMA.

REPORT OF PROGRESS FOR 1877 AND 1878.

BY
EUGENE A SMITH, PH. D.,
STATE GEOLOGIST.

MONTGOMERY, ALA.:
BARRETT & BROWN, STATE PRINTERS.
1879.

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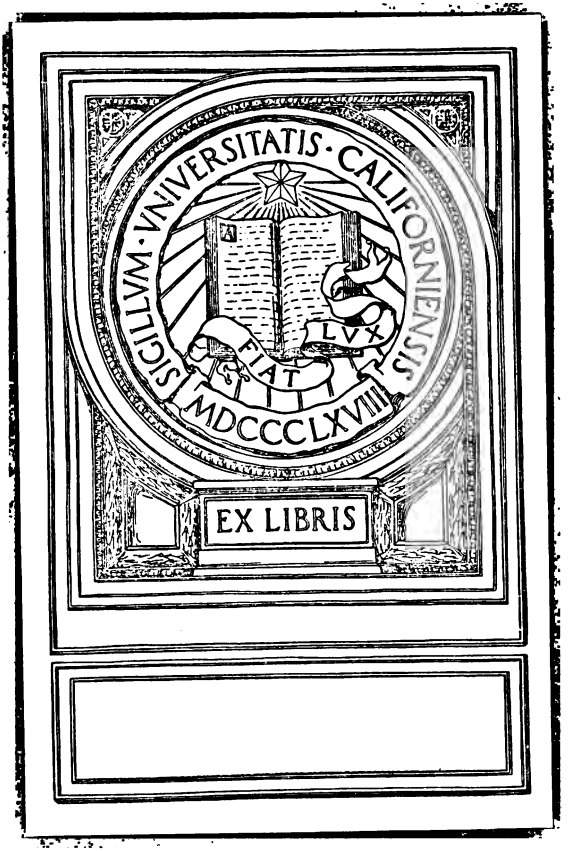

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To His Excellency,

RUFUS W. COBB,

Governor of Alabama:

SIR—The Report of Progress of the Geological Survey, for the years 1877 and 1878, is herewith respectfully submitted.

I have the honor to be, sir,

Your obedient servant,

EUGENE A. SMITH,

State Geologist.

UNIVERSITY OF ALABAMA,

January 15, 1879.

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PREFACE.

In previous Reports the Geological formations older than the Carboniferous, have been more particularly treated, and in accordance with the plan followed heretofore, of examining and reporting upon the formations in the order of their Geological age, the present volume will be devoted principally to the Carboniferous formation of the State.

The field work of the past season has been carried on in the Sub-Carboniferous areas of North Alabama and of Brown's Valley, and in the Coal-Measures of the Warrior Basin.

Whilst the geological structure of the terranes of other formations, can often be made out from natural sections, and without the aid of excavations, in the Coal-Measures the case is quite different, for the reason that the most exact knowledge is necessary of the thickness and relative position of the various seams of a field, and the Coal, being the softest and most easily eroded of the rocks, is always found covered with soil and other débris which have to be removed before it can be laid bare for inspection and measurement.

The sum appropriated by the State is barely sufficient to pay for ordinary expenses, leaving nothing for such work as would be absolutely necessary for the thorough exploration of a coal-field. I feel constrained to make this explanation, lest I should be thought responsible for the meagreness of the details concerning the coal seams, and the second-hand nature of many of the statements concerning their occurrence and thickness.

The maps accompanying this report, have been engraved and printed in the most satisfactory manner by Mr. JULIUS BIEN, the topography having been taken mainly from the large State map of Col. D. H. CRAM, who has kindly allowed this use to be made of it.

In the coloring I have departed from the usual custom of representing the Stratified Drift deposits, either by *dotting* the formations which they cover, or by leaving them out altogether as formation represented by a distinct color. My reason for this has been that in the Western parts of Fayette and Marion counties, the thickness of these beds is so great that the underlying formations have not yet in all cases been determined, and I have thought it best, where the Drift beds form the surface, and the underlying formations cannot be ascertained, to represent it so on the map.

The line of junction of Paleozoic and Cretaceous beds underneath this bed of sands and pebbles, will doubtless be traced out after some further examination, and the maps can then easily be changed.

Mr. HENRY MCCALLEY, of Huntsville, besides making for the Survey the analyses found in the body of this Report, has rendered very efficient aid in the field during the past season.

To Mr. T. H. ALDRICH, of Birmingham, I am particularly indebted for the information concerning the Coal-Measures of Jefferson County.

The ALABAMA GREAT SOUTHERN and the SOUTH AND NORTH ALABAMA RAIL ROADS have again placed the Survey under obligations for courtesies shown.

Finally, to the many citizens who have so kindly and in so many ways assisted in the prosecution of the work in the field, grateful acknowledgments are hereby made.

EUGENE A. SMITH.

UNIV. OF CALIFORNIA

REPORT.

CHAPTER I.

BASIN OF THE TENNESSEE IN NORTH ALABAMA.

By the term basin of the Tennessee, I mean to include in what follows, not only the immediate valley of that river, but also the whole country drained by its tributaries.

Under this definition, therefore, it will embrace an area on both sides of the Tennessee, from the State line on the north to the Coal Measures of the Warrior Field on the south.

That part of North Alabama in Jackson county, in which the river flows down the prolongation of the great Sequatchee valley, from Bridgeport to Guntersville, whilst it might properly be included in the hydrographic basin of the Tennessee, is much more naturally described in connection with Brown's valley.

I shall therefore, in the sequel, in speaking of this basin, describe only that part of it lying west of the Sequatchee or Brown's valley fold, beginning where the Tennessee breaks through the rim of the valley below Guntersville.

The average width from north to south of this drainage area, is about 45 miles.

The general features of the basin are those of a plain 12–15 miles wide, the valley of the Tennessee, through which the river flows in its tortuous path; the valley bounded both on the north and on the south, by hilly, and in some places almost mountainous country; the hills like the valley belonging to the same system, the configuration of the whole area being the result of erosion during long geological periods, by waters whose *present* representatives are the Tennessee and its tributaries.

TO MU
AIRONIAO

On the north the Highland Rim of Tennessee comes down into Alabama, forming the elevated country north of the Tennessee. This area is sub-divided, from an agricultural standpoint, into the "Barrens," and the *more fertile portions.*

The "Barrens" form a narrow belt in the extreme northern part of the State, characterized by a light colored siliceous soil which is not generally under cultivation. Within this division, however, are tracts with calcareous fertile soils.

South of the "Barrens," is the belt in which is included the valley proper of the Tennessee. The soil in this portion is calcareous, usually colored deep red, and is generally under cultivation. The face of the country is almost level, with the uniformity broken here and there by slight elevations, generally covered with trees and made up of fragments of chert. Upon these knolls are frequently situated the handsome dwellings of the planters.

Throughout this entire area *sink-holes* and *caves* are common and almost characteristic.

A second belt of the same character is found south of the main Tennessee valley, between what are known as the Little Mountains and the Main or Sand Mountain. Russell's and Moulton Valleys are here included.

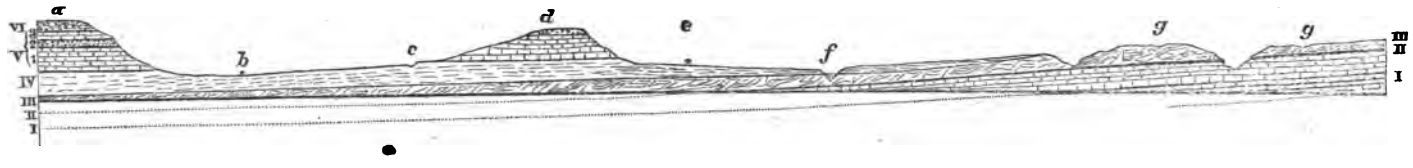
Separating the Tennessee valley from the parallel valleys just mentioned, is a belt of mountainous country which increases in height and is more widely separated from the main mountain as we go westward.

Thus in Morgan county south of Whitesburg, the *Little Mountains* are wanting as a distinct range, whilst in Lawrence and Franklin counties they become a prominent feature, separated from the main ridge by wide and fertile valleys.

GEOLOGICAL FEATURES.

The description of the geological structure of North Alabama, will, it is hoped, be made clear by the subjoined figure, which represents a general section north and south from the Tennessee line to the Coal Measures of the Warrior Field, through Courtland and Moulton.

FIG. 1. GEOLOGICAL SECTION THROUGH NORTH ALABAMA.



EXPLANATIONS.

I. Silurian. II. Black Shale. III. Lower Siliceous. IV. Upper Siliceous. V. Mountain Limestone. VI. Coal Measures. *a*. Sand Mountain. *b*. Moulton. *c*. Big Nance Creek. *d*. Mountain Home. *e*. Courtland. *f*. Tennessee River. *g*. "Barrens." *Scale*.—Horizontal, 1 inch = 6 miles; vertical, 1 inch = 1000 feet.

Below is given, in tabulated form, the geological formations of this part of the State, with their equivalents in other States. The numbering is the same as that of the figure above.

Formations.	Groups.	Equivalents.
Quaternary	VII. Stratified Drift	Orange Sand of Hilgard.
Carbonif. or Coal Meas.	VI. Coal Measures	Coal Measures.
Upper Sub-Carbonif.	V. 3, 2, 1 Mountain Limestone.	Chester Group.
Lower Sub-Carbonif.	IV. Upper Siliceous	St. Louis or Coral Limestone.
	III. Lower Siliceous	Keokuk and Burlington.
Devonian	II. Black Shale	Genessee Shale.
Silurian	I. Niagara	Niagara.
	(?). Hudson River	Hudson River.

The most important and widely distributed of these formations is the Sub-Carboniferous. It has been most closely studied in some of the Western States, particularly in Illinois, and, for this reason, the names given by the Western geologists, have been retained in the column of equivalents, wherever the identity of our rocks with those of the west has been recognized.

Lithological Characters and Distribution.

I. Silurian.—The rocks of this formation in North Alabama, are, beginning below, (1) a dark-colored earthy limestone, (2) gray magnesian limestone, and (3) bluish gray sandstone. The limestone (1) at the bottom of the series is supposed to belong to the Hudson River group of Lower Silurian; the other beds are members of the Niagara group of Upper Silurian.

These beds are exposed only in the bluffs of streams such as Elk River, Second Creek, Blue Water and Shoal Creek, which have their sources within the Tennessee line. The slight southern dip of the strata brings these lower formations nearer the surface in the extreme northern part of the State, so that they are within the reach of the denuding

waters of these streams. This is shown by the figure above given. Further south, the same strata pass under the overlying beds, and do not make their appearance again, until they emerge in the anticlinals of middle Alabama, on the other (southern) side of the Warrior Basin. The thickness of these beds in North Alabama is about 150 feet.

II. BLACK SHALE.—This is in Alabama the only representative of the Devonian System which is so well developed in the more northern States. It is a black bituminous shale with nodules of iron pyrites, generally poor in fossils, though occasionally in Lauderdale county, according to Prof. Tuomey, where the lower layers of this formation are siliceous, they are characterized by an abundance of a small brachiopod shell of the genus *lingula*. The average thickness is 6–8 feet, though it rises to 15 feet in some localities.

This bed, like the underlying Silurian rocks, is exposed in the banks and bluffs of the little streams which flow into the Tennessee from the north. Mr. Thomas Hatch, formerly of Florence, states that he has discovered the Black Shale on the Tennessee river, four miles east of Florence; this, so far as yet known, is its most southern exposure in North Alabama. This formation, like the Niagara, passes under the limestones of the Tennessee valley, and the Coal Measures, and emerges again in the anticlinals already mentioned.

III. LOWER SILICEOUS, KEOKUK AND BURLINGTON BEDS, "BARREN" GROUP.—The rocks of this lowest division of the Sub-Carboniferous formation, are, next above the Black Shale. 1st, a gray crinoidal limestone, full of fragments of stems of encrinites, form which circumstance it gets its name *encrinital limestone*. The character of this rock varies with the locality, from a pure sparry, almost crystalline limestone, admirably adapted to architectural purposes, to an impure argillaceous shaly limestone, becoming sometimes almost a calcareous shale. In many places it takes the form of a siliceous limestone filled with crinoidal stems, and sometimes, according to Prof. Tuomey, it becomes an ordinary coarse sandstone. The thickness is variable, in some places, being 100 feet or more.

Above this, occurs a series of siliceous strata, having sometimes a thickness of 200 feet. These beds are regularly stratified, and may be defined in general terms as siliceous limestones. The character of the rocks varies from impure limestone, to hornstone or flint; the most common form being a coarse cherty rock.

The crinoidal limestone (lowest bed) is shown along the banks of streams north of the Tennessee, and also in many localities, in the bluffs of that river. It has been much used in the construction of the locks of the Muscle Shoals Canal.

The *siliceous beds* are well exposed in most of the bluffs, where the limestone occurs, and in addition, they form the surface rocks over considerable territory along the northern boundary of the State, forming the so-called "Barrens."—This term does not imply absolute sterility of soil, but it is used rather to mark the distinction between these and the more fertile areas, in which the St. Louis limestone makes the surface. As the rocks of this group vary from impure limestones to bedded cherts, so the soils derived from them show varying degrees of fertility. Within the Barrens are many tracts in a high state of cultivation, with fertile calcareous soils.

The frequent occurrence of hard flinty strata in this formais the cause of the rugged, broken surface of the country made by it. Where it is best exposed in the Tennessee river, it forms the Muscle Shoals, which have been so well described by Prof. Tuomey.

South of the Tennessee, these beds pass below the overlying strata, to make their appearance again beyond the Warrior Coal Field.

IV. Upper Siliceous, St. Louis or Coral Limestone.—This is, in many respects, the most important formation of North Alabama, for from it are derived the soils which have made the valley of the Tennessee one of the best farming areas in the State. The rocks as a whole, are cherty limestones, fossiliferous, and sometimes argillaceous. The chert of this division is generally easily recognized, being found in nodular masses which are "usually highly fossiliferous,

abounding in lace-like *bryogoa.*" A large coral, *Lithostrotion Canadense,* is one of the most characteristic fossils and from it the formation gets its name.

The country made by this formation is generally level, with low knobs formed of fragments of chert, remnants of the cherty portions of the limestone. These chert masses are nearly always highly fossiliferous, they are sometimes much decomposed, weathering occasionally to a white, chalky looking siliceous powder. The soil overlying the St. Louis limestone is usually colored deep red and orange by iron oxide which has come from the limestone and chert.

Over much of the St. Louis limestone area the iron oxide has accumulated in banks which are sometimes extensive enough to justify working. Instances of the occurrence of these ore-banks, together with analyses of the ores, will be found below in the proper places.

The limestones of this formation appear to have suffered subterranean erosion to a greater extent than those of any other except perhaps the Quebec or Knox Dolomite.

As a consequence sink-holes, caves, underground streams, and "big springs" become almost characteristic of the St. Louis group.

Some of the caves are inhabited by great numbers of bats, whose excrements cover the floors sometimes to the depth of several inches. This substance might perhaps be profitably used as a manure.

The following analysis by Mr. Henry McCalley will show its composition:

Analysis of Bat Guano from North Alabama.

Moisture	61.016
Combined Water and Volatile Organic Matter	26.473
Phosphoric Acid	2.270
Sulphuric Acid	217
Ammonia	668
Nitrogen, existing as Uric Acid, &c	5.798
Lime	1.524
Magnesia	171
Potash and Soda	1.450
Insoluble Matter, Sand, &c	336
	99.923.

The St. Louis limestone occurs as the surface rock on both sides of the Tennessee river, forming the floor of the valley proper. This valley is bounded north by the hilly country formed by the Lower Siliceous rocks, and south by the Little Mountains, which are mere outliers of the main elevated plateau capped by the Coal Measures, and known as "the Mountain," or "Sand Mountain." Between the two mountain ranges, as will be seen by the figure, the St. Louis limestone is exposed again by denudation, and forms the surface in Moulton and Russell's valleys.

Both the upper and lower members of the Siliceous group pass under the Coal Measures, and reappear again in the anticlinal valleys further south; but there in diminished thickness, and not distinct from each other, the whole formation (siliceous) being cherty and fossiliferous. The thickness of the St. Louis limestone in North Alabama, will average perhaps 150 feet.

V. MOUNTAIN LIMESTONE, CHESTER GROUP.—This upper or calcareous member of the Sub-Carboniferous formation, is composed of limestones and shales with one bed of sandstone. The whole thickness of the group is between 650 and 700 feet in the eastern part of the valley near Huntsville, whilst it thins out westward to 100–150 feet in Lawrence and Franklin counties, with, exceptionally, a thickness of 350 feet.

The characters of the beds change also with the thickness, for near Huntsville they are mostly heavy bedded fossiliferous limestones with some shales, the sandstone bed being quite thin. In Lawrence, Colbert and Franklin counties, the limestones thin out and the sandstone bed becomes prominent, having often a thickness of 75 feet. In these western counties also, the sandstone bed is sometimes duplicated, the two parts being separated by limestone.

The Mountain limestone, as its name implies, outcrops (a) along the slopes of the spurs of the Cumberland Mountains in Madison county; and along the northern slopes of Sand Mountain in Morgan, Lawrence, and Franklin counties; also (b) on both slopes of the Little Mountains in Morgan, Lawrence and Colbert counties.

In the localities (a), it outcrops from beneath the sandstones and conglomerates of the Coal Measures, the interbedded sandstone (2), of the formation, forming generally a bench or bluff at some distance below the crest of the mountains.

In the localities (b), the formation makes up the principal mass of the Little Mountains, the sandstone bed (2) itself forming the cap of the mountain.

In Colbert county where such streams as Spring, Little Bear, Caney, and Buzzard Roost Creeks, have cut through the Little Mountains, they flow through deep gorges or canons with perpendicular sides, the sandstone forming the top rock, with the limestones below; by this arrangement the sandstones are undermined by the weathering of the softer underlying rocks, and break off leaving perpendicular cliffs.—These beds, like the others already described, pass under the Coal Measures, and emerge in the middle Alabama anticlinals where the sandstone bed becomes a heavy formation, whilst the limestones are thinned down to 75 feet thickness. The limestones are usually fossiliferous, the upper bed just beneath the Coal Measures being very generally a crinoidal limestone; lower down, the limestones are often argillaceous or shaly, generally well filled with fossils, prominent amongst which are *Pentremites* and *Archimedes*. Below the sandstone, the limestone beds are interstratified with shales; they are also fossiliferous and sometimes shaly.

The sandstone bed which, if a local name be desired, might be called the La Grange Sandstone, is fine to coarse-grained, sometimes heavy bedded, sometimes flaggy. Some localities, especially La Grange in Colbert county, are well known from the great number and excellence of preservation of the fossil plants included in the sandstone. Trunks of Lepidodendron, fragments of Sigillaria, and Calamites have been collected in numbers from this interesting stratum. In the middle Alabama anticlinals as yet, no fossils have been observed in this rock.

In a few localities in Colbert county, where good sections have been observed, the sandstone bed is duplicated, with

limestone between. In such instances the limestone passes into sandstone by becoming more and more siliceous, there being many places where it would be difficult to say whether the rock were limestone or sandstone. (See section at Mountain Mills in Colbert county, and near Pride's Station).

Between this sandstone and the strata of the Coal Measures, lie beds of limestone and shales, the uppermost bed being usually a crinodial limestone, full of fossils.

VI. Coal Measures.—The lower strata of the Coal Measures, as exposed in the escarpments of the Mountain in Madison, Morgan, Lawrence and Franklin counties, are about as follows: First above the crinoidal limestone, come thin-bedded sandstones, shales, and shaly sandstones, with two or three thin seams of coal. One of these coal seams in some localities, is thick enough to be worked, as for instance on Monte Sano near Huntsville. At this place the workable seam is about 40 feet above the topmost limestone bed of the Sub-Carboniferous formation; the thin seams being below the one worked. The thickness of these beds, including the coal seams, is variable; 75 feet might perhaps be taken as a fair average. Above these a bed of coarse grained sandstone, often a *conglomerate*, is usually observed. This rock forms generally a conspicuous bluff or bench along the sides of the mountains. In Madison and Morgan counties it has more the character of a conglomerate, whilst westward in Lawrence and Franklin counties it is generally a sandstone, and does not make so conspicuous a mark upon the mountain as it does in the first named localities.

In the anticlinal valleys south of the Warrior Field, (Murphrees', Jones', and Roup's), this rock is a prominent land mark, as it forms a well defined ridge along the edge of the valley. It is there underlaid by shales in which I believe no coal seams have yet been noticed. For further particulars concerning this bed and the Coal Measures overlying it, the reader is referred to the section treating of the Warrior Field.

VII. Stratified Drift or Orange Sand.—The beds of this formation appear in much greater thickness in the coun-

ties south of the Tennessee Basin, and for this reason a description is omitted here. Full details will be found under Fayette, Lamar and Marion counties.

KEOKUK (?).	Dark bluish gray, siliceous rock, weathering to shale in some localities, with a few fossil shells scarcely determinable.....	100 "

On comparison of this section with others taken further west in Lawrence and Franklin counties, the predominance of the limestone strata, and the insignificance of the sandstone bed in the Chester Group, are particularly noticeable. In ascending Monte Sano, the limestones of the Chester Group are seen first, just beyond the Cemetery, and over the rocks of this group the road passes to within 40 or 50 feet of the summit, where the Coal Measures begin.

A cold spring breaks out from beneath a bed of limestone near the top, and a few feet above this limestone, in some of the first sandstone beds, a thin seam of coal, two or three inches thick, was observed.

The top of Monte Sano is a level plateau, upon which have been built several dwellings, summer residences of the citizens of Huntsville. On the eastern side of the mountain a chalybeate spring issues from beneath a sandstone ledge. This is near the junction of the sandstones of the Coal Measures and the limestones of the Chester Group, and I give the section as there exposed.

COAL MEASURES, VI.	Sandstones to summit.....	75 feet
	Dark gray clay shales.....	4 "
	Shaly sandstones.....	4 "
	White plastic clay.....	2 "
CHESTER GROUP, V.	Gray compact limestone.....	

The town of Huntsville is upon the St. Louis limestone, and the highly cultivated lands in the vicinity and westward towards Athens, as well as southwestward towards the Tennessee river, are formed by the same rocks.

The chert with which this limestone is filled, is often highly fossiliferous.

Near the Athens road are occasional areas of Lower Siliceous rocks, which, near the State line, become the prevailing surface rocks in the Highlands or "Barrens."

MORGAN AND MARSHALL COUNTIES.

In the present report, it is only the eastern part of Morgan and the western of Marshall, that will come under consideration. South of Whitesburg on the Tennessee, the second bottom of the river in Morgan county, is two or three miles in width. The slopes of Sand Mountain border this second bottom. The lowest rocks exposed on this slope are the limestones of the Chester Group V, of the general section above. Above about 50 feet of these beds, there is a stratum of soft, friable, sandstone 20 feet perhaps in thickness. In this immediate vicinity this rock does not make any decided bluffs—but it forms the cap of a plateau some half a mile wide, and elevated about 75 feet above the river. This sandstone is the bed V, 2, of the section, and at this place it does not form a ridge separated from the main mountain by a valley as is the case in Lawrence and Franklin counties, but it merely makes a bench along the slope of Sand Mountain.

Above this sandstone, are the beds V, 3, of our general section, which are first thin bedded shaly sandstones, followed by calcareous shales, then blue fossiliferous limestones, thin bedded and shaly weathering into thin sheets; where the rock is much decomposed a great number of loose shells and other fossil remains, are formed in the clayey soil.

Above this, are compact blue limestones with occasional shale some 250 feet in thickness, followed by thin bedded gray limestone with layers of chert and shales, some 30 feet thick, up to the first ledge of sandstone of the Coal Measures, VI. The succession of these beds can perhaps better be seen by reference to the following

Section of Sand Mountain South of Whitesburg.

Coal Measures, VI.		(7) Shales and Sandstones, (top of mountain), with two thin seams of Coal, separated by 60 feet of other strata	150	feet
Chester Group, V.	3.	(6) Thin bedded gray limestones with shales, and cherty layers	30	"
		(5) Compact blue limestone with occasional shales	250	"
		(4) Thin bedded blue limestone with interstratified shales, weathering into thin friable sheets, containing *Archimedes* and other fossils	30	"
		(3) Calcareous shales passing downward into thin flaggy sandstones 1–2 inches thick	15	"
	2.	(2) *Ferruginous Sandstone*, soft and friable	20–25	"
	1.	(1) Limestone, compact, blue, fossiliferous	50	"
		Second Bottom of River		

The limestones here between sandstones No. 2 and No. 7, are 325 feet in thickness. Between the same beds on Monte Sano, according to Prof. Worthen's section, there are 400 to 420 feet of limestone beds.

At this point the sandstone No. 2 is somewhat thicker and of more importance than on Monte Sano, though when compared with the same bed further west, as at La Grange, Pride's Station, &c., it is *here* comparatively insignificant. At this place there are 150 feet of Coal Measures on top of the mountain, and by barometric measurements the highest point of the mountain along this road, is near the northern edge, where it is about 550 feet elevated above the river at Whitesburg.

Southward the measures sink, as may be seen by the following barometric observations :

Highest point along the road near northern edge of Sand Mountain.....550 feet above river.
Mr. Hill's—6 miles S. of Whitesburg, (S. 23 T. 6 R. 1 W.).....500 " " "
Mr. Black's, near corner of S. 8, T. 7, R. 1, E.....250 " " "
Oleander or Crop Roads, S. W. of S. 22, T. 7, R. 1, E.....225 " " "

At Mr. Black's the conglomerate is the surface rock, and a fine spring bursts up through it. Three miles west of this point, coal is reported in a bed two feet thick. The Coal Measures at this place (Mr. Black's), are only about 100 feet in thickness, limestones of the Chester group being exposed in ravines, at about that distance below the level of the road.

At Oleander, a thin shaly seam of coal is struck in wells about 25 feet below the surface.

South and east of Oleander the Measures rise again to the rim which borders Brown's valley on the northwest side. I have no data for determining the height of this rim above the river level, except eastward from Oleander towards Warrenton.

Southward from Oleander a bed of coal is known which is some 100 to 150 feet above the level of that P. O.

Between Oleander and Warrenton the highest points crossed by the road are about 425 feet above the river. Along this road at several points, but more particularly on Shoal Creek at Ragsdale's Mill, the conglomerate is well exhibited. Here the creek has cut through this rock, to a depth of 30-40 feet, and into this gorge the water pours over two falls, nearly equal in size and beauty to the falls of Clear Creek in Winston county, where the rock is also a conglomerate, probably the same as this. Ragsdale's Mill is 250-275 feet above the river by barometric observation.

Below this conglomerate on Shoal Creek, in S. 21, T. 7, R. 2, E., and one and a quarter miles north of the mill, a bed of coal 8-12 inches thick is exposed under a rock bluff.

The conglomerate here is a mass of quartz grains, holding small rounded pebbles of white quartz, about the size of peas.

This rock is well shown along the western rim of Brown's valley, two miles west of Warrenton; and the ridge continues on in a north-east direction to the river opposite Fort Deposit, at which place it is cut by the Tennessee; but the continuation of it is probably found on the other side running through Jackson county.

CHAPTER II.

BASIN OF THE TENNESSEE.—*Continued.*

LAUDERDALE AND LIMESTONE.

In the present report, it is intended merely to give the results of a reconnoisance of the lower parts of the two counties named, together with a few sections taken at various points, by Mr. Thos. P. Hatch, and which are furnished through the kindness of Dr. James M. Safford.

In these counties, the following formations have been recognized, the numbers corresponding to those of the general section above:

QUATERNARY.	VII.	Stratified Drift, or Orange Sand.
SUB-CARBONIFEROUS.	IV.	St. Louis or Coral Limestone, Upper Siliceous.
	III.	"Barren" group, Keokuk and Burlington, Lower Siliceous.
DEVONIAN.	II.	Black Shale.
SILURIAN.	I.	Niagara.

The strata of the Siliceous group(St. Louis limestone, and Keokuk) make up the greater part of the superficial area of both counties: the lower formations, Black Shale and Niagara, being exposed only in the vicinity of the Tennessee line, where Elk River, Shoal, Cypress and other creeks have cut down through the overlying beds.

The strata have a slight southern dip as is shown by the disappearance of the lower formations towards the south, in which direction they pass under the carboniferous rock, whilst near the State line, they are exposed along the banks of most of the streams.

That part of these counties in which the strata of the Lower Siliceous group form the surface, has received the

name of "the Barrens," from the fact that the soils are not generally so productive as those formed from the overlying St. Louis Limestone. The soils are usually more or less sandy, and gray in color, though areas of fertile calcareous soils are not at all rare. The face of the country is also broken and hilly.

Where the upper Siliceous, or St. Louis Limestone forms the surface, the country is much more level, and more generally cultivated: occasional slight elevations formed by the débris of the more cherty portions of the limestone, and usually timbered, form an agreeable variation of the scenery, which is otherwise that of an unbroken plain almost entirely under cultivation. The soil is calcareous, generally colored deep red or orange by iron, and unusually fertile. Wherever the limestones of this formation prevail "sinkholes" are numerous.

The drainage of this entire area is southward into the Tennessee river.

DETAILS.

A general section of the strata of the upper part of Lauderdale county, made by Mr. Hatch, is as follows:

QUATERNARY VII.	1. Conglomerate, Siliceous pebbles cemented by iron.	
SUB-CARBONIFEROUS (*Lower Siliceous.*) III.	2. Ferruginous cherty strata, much decomposed.....	25 feet.
	3. Flinty strata.....	60 "
	4. Siliceous Shale.....	8 "
	5. Gray crinoidal limestone.	110 "
DEVONIAN. II.	6. Black bituminous slate (Black shale)	8 ft.
SILURIAN. I.	7. *a.* Bluish gray Sandstone. *b.* Gray limestone. *c.* Dark earthy limestone.	...150 ft.

This general section has been compiled from observations of exposures at various places in the county, particularly on Shoal Creek, Blue Water Creek, and on Elk River.

To the above may be added IV, Upper Siliceous, which is the surface formation of part of the county.

Mr. Hatch found some variation in the strata just overly-

ing the Black Shale. Thus, on the Tennessee River, four miles east of Florence, he found the Black Shale a little above the water's edge. At this point and on Second Creek, about four miles from the State line, immediately above the Black Shale, is a bed of dark shaly argillaceous limestone, 30–50 feet in thickness. In this, fossils are comparatively rare, and upon it rest the cherty strata.

At the mouth of Elk River and on Shoal Creek, the crinoidal limestone, full of fossils, overlies directly the Black Shale.

The same bed of crinoidal limestone overlies the Black Shale also at Blair's Ferry on Elk River, on Sugar Creek, and on Blue Water Creek at the State line. (Hatch.)

Between Woodland and Florence, the country is made by the St. Louis limestone, and it is a beautiful, slightly rolling farming land. Underneath this, beds of the lower Siliceous (Keokuk, &c.) come in, and are exposed along the banks of Cypress Creek and other streams. Thus, on Cypress Creek the cherty beds No. 3 are seen at the crossing. Limestone, with nodules of chert, forms the bed of the creek, and above this, 18 inches of bedded chert, and over this limestones with strings of irregular chert concretions which give to the bluff formed by the limestone, a very rough, knotty surface.

The deep gullies seen by the roadside near Florence, expose angular masses of chert imbedded in a yellowish loam to the depth of 8 or 10 feet. This has no resemblance to the ordinary Stratified Drift, for the siliceous fragments are angular, showing that they are nearly in place, and have not been transported like the rounded pebbles of the Drift.

A fine section of these flinty limestones, is shown in the bluff at the end of the bridge opposite Florence, where about 175 feet are exposed. The rock is a blue siliceous limestone, which weathers in places into a porous brown siliceous rock with very rough surface. The lower layers of the section exposed here probably represent the dark shaly argillaceous limestone described by Mr. Hatch as overlying, along the Tennessee River, the Black Shale.

Further up the river, just below the mouth of Blue Water

Creek, the cherty limestones are well exposed by the side of the canal. The bluffs are 25–30 feet in height; the limestone layers offer unequal resistance to weathering, and an overhanging ledge is left some ten feet thick, near the top. Where the rocks have been long exposed, strings of nodules, or irregular seams of chert between the beds of purer limestone, stand out in bold relief, furrowing the face of the bluff.

Near Lamb's Ferry on the southern bank of the river, about 50 feet of the argillaceous limestone are overlaid by the more cherty layers. They probably correspond to Nos. 5 and 3 of Mr. Hatch's section. Across the river, whilst no vertical exposures are seen near the road, a somewhat similar succession of rocks may be observed: the lower beds being hard shaly limestones, with siliceous limestones holding strings of nodules of chert above. Along with these rocks are numerous geodes lined inside with quartz crystals. The siliceous or cherty limestone shows many variations; at times it is a limestone with very little siliceous matter, which is in the shape of concretions, at times the siliceous matter seems to impregnate the entire mass, which upon weathering presents the appearance of a porous siliceous rock, sometimes almost a sandstone. Where rocks of this character form the surface, the soil is light colored, yellowish to white, not much cultivated.

Between Rodgersville and Blair's Ferry, bluish shaly limestones form the lowest beds seen in ravines and depressions; over these, are alternations of cherty limestones, with beds of chert and the porous siliceous rock mentioned above.

Between Blair's Ferry and Athens, the road is over the upper beds of the Lower Siliceous, the soil grayish or white, on the higher lands especially, which are timbered with white, post, red, and black-jack oaks, sweet gum and sour gum, with a scanty undergrowth of chestnut and sour wood. The general elevation of this road above the Tennessee at Lamb's Ferry, is 200 to 225 feet.

Near Athens the soil changes in character, becoming redder in color and more fertile, and as a consequence, cleared fields and large farms are more frequently seen. This change is due to the fact that the St. Louis limestone (Upper Siliceous) forms the surface.

Between Athens and Huntsville these red soils predominate; but occasionally the lower Siliceous beds make the country and give the usual light colored soil of the "Barrens."

The St. Louis limestone is cherty in places, and the fragments of this chert are usually the only rocks seen in the terranes formed by this limestone.

As a general thing the chert is full of fossils, crinoidal stems, brachiopods, and bryozoans. Many fragments will show inside an unchanged nucleus of chert, whilst the outer parts are porous white, chalky, and friable. In the undecomposed nucleus the fossils are scarcely to be detected, but where the decay has progressed they become very evident.

LAWRENCE COUNTY.

Topography.

Crossing this county from east to west near its southern part, is a mountain escarpment which forms the divide between the waters flowing into the Tennessee and those flowing into the Warrior.

Between Moulton and Courtland is another ridge (the "Little Mountain"), running like the first, east and west. This ridge is cut by all the streams flowing north into the Tennessee, and it separates the Moulton Valley on the south from the Tennessee valley on the north. The county is thus divided into four belts: two with prevailing sandy soils, formed by the two mountain ridges; and two with calcareous or limy soils occupied by the two great valleys mentioned.

Geological Formations.

1. *Distribution.*—In Lawrence county the surface is made up of two formations; the Sub-Carboniferous III, IV, and V, and the Coal-Measures VI. To these may be added, in a few localities, the Stratified Drift, VII.

The surface distribution of these formations is as follows: in the southern part, upon the Sand Mountain, is a belt of Coal-Measures six or eight miles wide; it includes all from the summit of the mountain southward to the Winston county line.

North of this belt to the Tennessee River the country is formed by the Sub-Carboniferous rocks.

Upon the summit of the mountain, especially in the southwestern part of the county, there are superficial beds of pebbles and sand belonging to the Stratified Drift, and these materials may probably also be found in isolated patches in

the western part of Moulton valley near the Franklin county line.

2. *Sub-Divisions.*—As in Franklin and Colbert counties, so in this, the subdivisions of the Sub-Carboniferous formation, are well represented. They are as follows:

V. Upper, or Calcareous.—Mountain Limestone. Chester Group.

IV. Upper Siliceous.—St. Louis or Coral Limestone. St. Louis Group.

III. Lower Siliceous.—Barren Group. Keokuk, &c.

The greater part of the two valleys mentioned above, is formed by the St. Louis limestone, whilst the slopes of the two mountain ridges and the summit also of the Little Mountain, are made by the strata of the Mountain Limestone.

The Coal-Measures, occupying as they do, only the summit of the mountain in the lower part of the county, are sparingly represented, and probably by the lower members only of the series.

DETAILS.

On the road leading from Houston to Moulton, the summit of the Mountain at the gap, is about 250 feet elevated above the limestone of the valley, and about 300 feet above Moulton. The summit, as has already been stated, is formed of the sandstones and shales of the Coal-Measures, whilst the escarpment overlooking the valley is made up chiefly of the limestones and other strata of the Mountain Limestone or Chester Group. Moulton valley has for its surface rocks partly, the shaly limestones of the lower part of the Chester Group, and partly, the upper beds of the St. Louis Limestone or Upper Siliceous Group.

Between Moulton and Courtland a fair section of the Mountain Limestone can be made. Four miles from Moulton, at the crossing of Big Nance Creek, sandstones and shales are exposed in beds of varying thickness, and beyond this point to Mountain Home, the road rises gradually over the strata of the Little Mountain—sandstone and shales

chiefly. At Mountain Home the elevation, by barometric observation, is 150 feet above Moulton, and the crest of the mountain overlooking the Tennessee valley, is some 50 feet higher still, or not more than 100 feet lower than the summit of Sand Mountain at the gap south of Moulton. The strata here, evidently fall away towards the south, for between the crossing of Big Nance Creek four miles north of Moulton, and the escarpment or summit of the Little Mountain, a distance of 6–8 miles, there is an ascent of 150 to 175 feet, principally over sandstones, whilst on going down the mountain towards Courtland, limestone is encountered 50 feet only below the summit, and at a distance of 125 feet below the same summit, limestone, with a great quantity of *Archimedes* and other fossils of the Chester Group.

By referring to the sections of Sub-Carboniferous strata in Franklin and Colbert counties, it will be seen that the Little Mountain owes its present height to the fact that a stratum of sandstone, one of the beds of the Chester Group, occupies its summit, and has protected it from denudation. This stratum, which is so marked a feature of the Chester Group in this and the adjoining counties, is the *Lower Sandstone* of Prof. Tuomey, and if a local name were needed, it might be called the *La Grange Sandstone* from its occurrence in that well known locality, where it holds the remarkable fossils spoken of below.

At Mountain Home this sandstone is 20 feet or more in thickness, and is underlaid by shales, the wearing away of which has, in places, undermined the sandstone, thus forming overhanging ledges or "rock houses." The beautiful spring at Mountain Home issues from beneath one of these ledges. The most beautiful, and often rarest, ferns of the State find a congenial soil and other conditions of a luxuriant growth, in these sheltered spots. *Asplenium pinnatifidum*, and *Aspl. montanum*, are most abundant.

As has been stated above, 125 feet below the sandstone summit of the Little Mountain, there is a fine locality for Chester fossils. The shaly limestone which holds these

fossils, forms a level, or nearly level, plateau, the surface of which is covered with the shells.

One hundred and seventy-five feet below the summit, are seen fragments of chert, probably weathered out from the limestone of the St. Louis Group, and this limestone forms the surface thence out to the Tennessee river. The valley at Courtland is, by barometric observation, 375–400 feet below the summit of Sand Mountain, south of Moulton.

What is said below concerning the Tennessee valley in Colbert county, will apply also here. It is in general a level plain with a red soil of great fertility. The greater part of this plain is under cultivation, but slight elevations with dense growth of oaks, mark the localities of cherty portions of this limestone. The chert fragments which form these slight elevations, are full of the lace-like impressions of *bryozoa*.

Throughout the valley these elevations are not unfrequently occupied by the dwelling houses of the planters, overlooking the fertile plains below.

Near the river the siliceous limestones of the underlying Lower Siliceous Group III, form bluffs, occasionally 50 to 75 feet in perpendicular height. Near Lamb's Ferry a bluff of this kind is made up of sparry crinoidal limestone with alternations of shaly and argillaceous limestone and strings of cherty nodules.

At Green's bluff, opposite the mouth of Blue Water Creek, a similar series of rocks is found.

On the opposite side of the river, in Lauderdale and Limestone counties, the exposures of these silico-calcareous rocks are better seen, and a more detailed description of them will be found under those counties.

Southwest of Courtland, the escarpments of the Little Mountain extend in a broken range towards LaGrange. The sandstone caps the mountain everywhere, and forms bluffs of considerable height in many places. The outline of the mountain against the valley is irregular, mountain spurs with limestone coves between.

The old camp ground near Town Creek, is situated in one

of these coves, surrounded on three sides by the bluffs of LaGrange sandstone.

Between Courtland and the summit of Sand Mountain, south of Mount Hope, a section of the Sub-Carboniferous strata, up to the Coal Measures, is well exposed.

Along this road the shaly fossiliferous limestones of the Chester or Mountain Limestone Group, are encountered near the foot of the Little Mountain, at a height of 50 feet above the railroad. At 75 feet a nearly level plateau of considerable width is attained, rising towards the south. The soil upon this plateau is a stiff yellowish, and in places, whitish clay.

At an elevation above the railroad of about 110 feet occurs a bed of sandstone, and above this a ledge of limestone several feet in thickness. This, in turn, is overlaid by sandstone, which forms the mountain summit, at the point of crossing, something more than 175 feet higher than the railroad. The prevailing growth upon the mountain in this and the adjoining counties, is a mixture of Spanish, black, white, red, and post oaks, chesnuts, hickories, and short leaf pines. In some localities the pines prevail, and in others the oaks. Across the sandstone capping of the mountain, the distance is only four or five miles, then begins a descent into the Moulton or Mount Hope valley. The level of this valley is not much above that of the Tennessee valley, from which it is separated by the Little Mountain. The surface rocks here, as in the Tennessee valley, are chiefly the limestones of the St. Louis Group, but near the foot of the mountain, on each side, the Chester or Mountain limestone forms the surface.

Near the foot of the mountain, in the northeast corner of section 28, township 7, range 9, west, below Steenson's gap, strata of Mountain Limestone, with characteristic fossils, are encountered at an elevation of 150 feet above the railroad; below this are probably beds of considerable thickness of the shaly limestones of the same group, an exact measurement of which was not made. A section of the strata from

the Mount Hope valley level, up to the summit at Steenson's gap, a distance of four miles, is nearly as follows:

Coal-Measures VI.	(7.) Sandstones, alternating with shales and shaly sandstones, all showing considerable iron oxide—passing downwards into clay shales, with much iron oxide, partly in the form of sandy iron ore.....	100 feet.
	(6.) Coarse grained sandstones forming bluff, underlaid with shaly and fine grained sandstones—together.....	100 feet.
Monntain Limestone or Chester Group, V.	(5.) Limestone with fossils.....	25 feet.
	(4.) Siliceous sandstone, composed of rounded grains of quartz, dark colored from the oxide of iron.....	65 feet.
	(3.) Limestone with fossils.....	35 "
	(2.) Slope with clayey soil, strata not seen, probably argillaceous limestones (estimated)	100 feet.
St. Louis, IV.	(1.) Cherty limestone at lowest level (estimated).....	50 feet.
		475 feet.

In this section the relative thickness of the first two strata are estimated, and may differ considerably from the figures given. The other measurements were made with the barometer, and are approximately correct.

No. 4, is probably the equivalent of the LaGrange sandstone which forms the summit of the Little Mountain.

At the summit at Steenson's gap, the rocks of the Coal-Measures are covered in places with beds of pebbles and sand belonging to the Stratified Drift. The crest of the mountain overlooking Mount Hope valley, has only a thin covering of these Drift Materials, but further south the the thickness increases.

Near the gap are reported occurrences of coal in many localities—these beds belonging, in all probability, near the bottom of the Coal Measures.

COLBERT COUNTY.

Topography.

East and west, through this county, runs a range of hills called the "Little Mountain," north of which lies the valley of the Tennessee, and south, Russell's Valley. Towards Russell's Valley the hills are covered with thick beds of pebbles, whilst towards the Tennessee valley the mountain sinks down rather abruptly, leaving an escarpment uncovered by pebbles.

All the streams of the county flow into the Tennessee, and all have their sources in the mountains north of Russell's Valley. In their courses towards the Tennessee, they have all, especially towards the west, cut gorges or small canons into the sandstone which forms the upper stratum of the Little Mountain. After leaving the mountain, they flow through the comparatively level valley towards the river.

In these mountain gorges are many scenes of wild and rugged beauty; and it is not strange that the chalybeate springs, which are so common there, have been so much frequented.

Geological Formations.

The geological relations of Colbert county are comparatively simple. The formations represented are two: (1) the Sub-Carboniferous, IV and V; and (2) the Stratified Drift, VII.

The Drift is found chiefly in the southern part of the county, on the borders of Franklin, and the beds of this age are of the usual type, viz: pebbles and sand. The pebbles are principally angular fragments of chert, often filled with casts and impressions of Sub-Carboniferous fossils. These beds have their greatest thickness near the Franklin line, thinning out towards the north upon the mountain.

The Sub-Carboniferous beds form by far the greater part of the surface rocks of the county. The Valley of the Tennessee is formed by the siliceous limestones of the St. Louis group. IV, whilst the more rugged and hilly portions of the county are formed by the strata of the Mountain Limestone or Chester Group, V.

A few sections will make plain the relations of the Mountain Limestone and St. Louis group, in Colbert county.

The first section which I will give, is taken at the cotton factory near Barton's Station.

Section of Mountain Limestone, near the Mountain Mills, Colbert County.

MOUNTAIN LIMESTONE OR CHESTER GROUP, V.	(5) Loose rocks and some pebbles forming surface, probably covering limestone	25 feet.
	(4) Sandstone forming a cliff	55 "
	(3) Slope, strata not seen (probably limestone)	70 "
	(2) Sandstone and siliceous limestone forming cliffs	50 "
	(1) Fossiliferous limestone, not often seen, except in the gullies—makes a very heavy, sticky clay soil	150 "
		350 feet.

Number 2 is peculiar, consisting of alternations of sandstone with highly fossiliferous limestone, containing *Archimedes*, &c. Some layers in this bed are highly siliceous limestones or calcareous sandstones. These strata together form a series of perpendicular cliffs, about 50 feet vertical height.

Number 4 is a fine grained sandstone, forming the upper series of cliffs, which are at the point measured, about 50 feet in height. On top of this sandstone were beds of loose material.

Slopes 3 and 1 are covered usually with fragments of the sandstone of the overlying beds; but they are made up of fossiliferous calcareous rocks, as may be seen where exposures are made by washes or other cause.

These cliffs are shown all along the banks of Cane Creek, of Buzzard Roost Creek, and particularly along Rock Creek. They are caused by the erosion of the underlying softer beds, and the breaking off by vertical planes of large blocks of the sandstones thus undermined. Near the sources of some of these creeks, as at Newsom's Springs on Cane Creek, water, strongly impregnated with iron, issues from this upper sandstone. Chalybeate springs, having their origin in the same stratum, are well known and frequented in other parts of the county.

At Newsom's Springs the gorge of Cane Creek has perpendicular sides, some fifty feet or more in height, and at the bottom of this cliff, a rapid slope down to the water's edge.

Under the overhanging sandstone, is found the spring, and the sheltered spot under the cliff has been utilized as a hall for various amusements, ten pins, concerts, &c.

Near Prides' Station, on the M. & C. R. R., are cliffs of the same sandstones. A section of the strata exposed in these cliffs and the hills which they cap, is as follows:

Section of Mountain Limestone (Chester), and St. Louis Beds in the vicinity of Prides' Station, Colbert County.

Mountain Limestone or Chester Group, v.	(5) Siliceous sandstone, composed of clear glassy crystals of quartz cemented together—forming cliffs...	50 feet.
	(4) Limestone highly fossiliferous....	25 "
	(3) Sandstone and siliceous limestone, the limestone bands often quite pure and full of fossils; these beds form also a series of cliffs....	25 "
	(2) Shaly fossiliferous limestone (with Archimedes, &c.) yielding a stiff clayey soil which forms a gentle slope covered with fragments of fossiliferous limestone and of sandstone, from the overlying beds.....	75 "

St. Louis Limestone, iv.	(1) Bedded Chert, or cherty limestone, to river level, generally full of casts of fossils (bryozoa being most abundant and characteristic). The upper of these beds form the general surface of the valley; it yields by disintegration a deep red colored soil, with here and there low knobs formed of the chert fragments.....	100 "
		275 feet.

This section is from the river level up to the top of the first hills south of the river, a distance of one and one quarter miles. Whilst the cherty limestones, No. 1, are mostly St. Louis limestone, it is possible that the lowest beds may belong to an underlying group—Keokuk, perhaps.

The siliceous limestone, No. 5, is much like what has usually been called Millstone Grit in middle Alabama, and from a section at Boyle's Gap in Jefferson county, on the S. & N. Ala. R. R., given at another place, it seems quite probable that this sandstone is, in geological position, similar to the lowermost of the siliceous sandstone beds which form the mountain rim of the valley at that point. This subject will be more fully discussed in another place.

A third section, extending from the river near Florence, through Tuscumbia to La Grange, at the top of the mountain, shows the following:

Mountain Limestone or Chester Group, v.	(8) Reddish sandy shales, and thinly bedded reddish colored sandstones, forming summit of mountain at La Grange	35 feet.	
	(7) Heavy-bedded siliceous sandstone, forming cliffs	30 "	
	(6) Gray crinoidal limestone, full of fossils, the lowest two or three feet, of reddish color, with bryozoa, brachiopods, and other fossils	50 "	
	(5) Slope, strata not seen, but presumably shaly limestone, surface covered with sandstone fragments	65 "	
	(4) Bluish, and yellow shales	10 "	
	(3) Shaly fossiliferous limestone, yielding a heavy clay soil	25 "	
Upper Siliceous or St. Louis Group, iv.	(2) Cherty limestones, yielding deep red colored soil, and forming the general level of the valley, passing downwards into.	Together	150 ft.
Lower Siliceous, iii.	(1) Heavy-bedded silico-calcareous rock, weathering into porous brown siliceous rock, very rough on surface. These siliceous beds form the bluff on the river at the bridge opposite Florence.		
			365 ft.

The St. Louis Limestone, No. 2, forms here, as elsewhere in the valley, the general surface of the country. The land, underlaid by it, is usually nearly level, with slight undulations formed by the débris of the cherty portions of the limestone. These knobs are covered with a thick growth of oaks, and form an agreeable relief to the otherwise monotonous, open, cultivated plains.

The weathering of the St. Louis limestone gives rise frequently to under-ground water courses, which, in places, come to day, forming "big springs." A noted instance of this kind is the spring at Tuscumbia.

The heavy bedded siliceous sandstone, No. 7, is the same as No. 5 of the foregoing section. It forms here, as there, a

series of cliffs. At La Grange, this stratum is famous for the abundance and large size of the fossil remains of plants found in it.

This locality was first brought to notice by Prof. Tuomey, in his second Report. Some of the most remarkable of these fossils were brought together as long ago as 1853, by Prof. J. W. Hardy, then President of La Grange College.

The finest specimen is a fragment of trunk of Lepidodendron, showing distinctly the leaf impressions. This fragment is about three feet in diameter and four feet high. It is of sandstone, and is otherwise remarkable from the fact that the sandstone of which it is composed is full of impressions of other plants, calamites, &c. These impressions can be seen in the cross-section of the trunk, at the lower end, and they would appear to show that, in the process of petrefaction, the interior of the trunk was removed by decay or othwise, leaving a hollow cylinder of the outer layers of the trunk (bark, perhaps), and this hollow cylinder was filled up with sand and fragments of calamites and other coal plants. The subsequent induration of the sand, and the removal of the shell of vegetable matter which formed the mould would give the fossil as we now find it. Another specimen showing the leaf scars very imperfectly, if at all, is remarkable for the reason that it is the lower part of a trunk, about the size of the preceding, but with two large roots attached. Other specimens of smaller size, but sometimes more distinctly marked, have also been collected. The specimens above described are now in the Cabinet of the Survey at the University.

The larger specimens mentioned, were discovered on a hill about one mile from La Grange; but all the gullies which furrow the sides of the hill below the town on either side, are constantly exposing fragments of these remarkable plants.

FRANKLIN COUNTY.

Topography.

The principal streams of this county are Town Creek, Spring Creek, Little Bear Creek, Cane Creek, and Big Bear Creek with its tributaries, Cedar Creek, Rock Creek, and Buzzard Roost Creek.

With the exception of Big Bear Creek, these streams all have their sources north of what is known as "The Mountain," which is an escarpment of the Coal-Measures overlooking the valley.

Big Bear Creek, on the other hand, takes its rise south of this escarpment, and flows at first southwest, as though a tributary of the Tombigbee, but its course is soon changed to westward, and then northwestward by an accumulation of pebbles and sands, and it then breaks through the mountain on its way northward to the Tennessee.

This pebble ridge is a noticeable feature of the topography of Franklin county. Overlying the Coal-Measures, it forms an irregular crescent, beginning in the southeast of Franklin, bending down into Marion, and returning again into Franklin county near its southwestern corner. The waters north of this dividing ridge flow into the Tennessee; south of it, into the Tombigbee.

The extraordinary deflection of Big Bear Creek, caused by this ridge, has just been mentioned, and it is an interesting fact that the waters of Big Bear Creek, on the north, are some 50 feet or more higher than those of the tributaries of the Tombigbee on the south, though the two are only a few miles apart.

Geological Formations.

In Franklin county, the formations represented are, (1),

The Coal-Measures, VI; (2), The Lower or Sub-Carboniferous, V and IV; and, (3), The Stratified Drift, VII.

(1). *Coal-Measures.*—The northern limit of this formation is an exceedingly irregular line, formed by ridges with limestone coves between. East of Russellville, these mountain prongs extend northward as far as the middle of township 7, and a few project still further northward. West and southwest of Russellville, the line is less regular, and cannot well be described without the aid of a map. The irregular line of mountain-spurs, with interlocking coves, runs from Russellville south and southwest to near the middle of township 8, range 14 west, and thence southward into Marion county. Except near the southern line of the county, the strata of the Coal-Measures are found only near the summit of the mountain. For this reason their thickness is not great, and I believe there is no point on the mountain where any coal bed is worked in the county, but a bed of coal is reported in two localities near Waco: *e. g.* four miles south, and two and one-half miles southeast of that place. Towards the west, the Coal-Measures and the underlying Sub-Carboniferous formation are buried deep under great beds of pebbles and sand, so that it is only occasionally that the underlying rocks can be seen.

(2). *Sub-Carboniferous.*—The strata of this formation, found in Franklin county, belong to the subdivisions given below, in which the numbering corresponds with that of the general section at the head of Chapter I.

The sub-divisions are:

SUB-CARBONIFEROUS. { *Upper, or Calcareous*, (V). Mountain Limestone—Chester Group.
Lower, or Siliceous, (IV). Upper, or St. Louis Limestone.

The strata of the Lower, or Keokuk Group (III), of the Lower Siliceous, have not yet been observed in Franklin.

From a section taken a few miles south of Russellville,

the character of the Mountain Limestone in Franklin county may be tolerably well seen.

Coal-Meas.	VI.	(6) Sandstone and shales, to summit of mountain	75	feet.
		(5) Sandstone, siliceous	50	"
Mountain Limestone,	V.	(4) Limestone with *Pentremites*, *Archimedes*, and *crinoidal* buttons	25	"
		(3) Sandstone	25	"
		(2) Limestone, shaly, with *Pentremites* and *Archimedes*	75	"
		(1) Argillaceous limestone, with large *cyathophylloid* corals (*Zaphrentis*)	40	"
			290	feet

This section is from Cedar Creek to top of the mountain, along the Tuscaloosa road. No. 1 may belong partly to the St. Louis group. The Sandstone, No. 3, is the Lower Sandstone of Prof. Tuomey.

(3). *Stratified Drift.*—In the western part of the county, thick beds of pebbles and sand cover all the underlying formations. These accumulations appear to have filled up the valley to the height of the rim of Coal-Measures. This rim, however, in the western part of the State is by no means so high as eastward, for instance near Huntsville. Through these beds of pebbles, &c., the tributaries of Big Bear Creek have cut their channels, down to the underlying limestones. A section of the rocks between Burleson and Nauvoo, for instance, shows that the streams have cut down into an encrinital limestone, to a distance of fifteen or twenty feet. Above this limestone are often found the remains of beds of chert of St. Louis age, and above this the Drift. Pebbles or angular fragments of this chert, sometimes cemented by hydrated ferric oxide into a conglomerate, make up a good part of these Drift beds, up to a height above the water courses, of one hundred feet. Above this height there are chiefly sands, with occasional masses of ferruginous sandstone, formed by the cementing together of the grains of sand by hydrated ferric oxide. The soil upon such high lands is light ash colored.

A close examination of the pebble beds of this and the two counties south of it, shows pebbles of two sorts, viz: angular fragments of Sub-Carboniferous chert, and rounded pebbles of quartz. The former are found near the western limit of the Coal-Measures in Franklin, Marion, and Lamar counties, and, from their shapes, it would seem that they have not traveled so far, nor suffered so much attrition as the quartz pebbles. In many cases, they seem to be fragments of underlying or neighboring Sub-Carboniferous (St. Louis) chert beds. On the other hand, the harder quartz pebbles are smoother, less angular, and they spread eastward over the eastern parts of Franklin, Marion, Fayette, and the western parts of Winston and Walker, being apparently much more abundant eastward, as, for instance, between Central Marion and Fayette out to the Byler ridge. Occasionally, west of the limit of the Coal-Measures, rounded pebbles of quartz may be found amongst the angular ones of chert; but they are not common. The larger rounded quartz pebbles are more frequently found near the water courses than elsewhere.

Details.

In the southwestern part of Franklin county, the Drift covers the country south of Big Bear Creek. This Drift is composed of angular chert pebbles in its lower parts, and above, mostly of sands, sometimes cemented into ferruginous sandstones, with occasional occurrences of tolerably good limonite. In crossing the water-shed between Bull Mountain and Big Bear Creeks, we descend (geologically) through the Drift into the underlying Sub-Carboniferous limestones (Chester and St. Louis groups), which are exposed along the banks of Big Bear Creek. By aneroid observations, the water level in this creek, at Burleson, is at least 75 or 100 feet above the waters of Bull Mountain Creek, near the postoffice of that name in Marion county. If these observations can be relied upon, there is considerable dip of the strata towards the south and west, for on Bull Mountain Creek strata of the Coal-Measures are exposed, whilst on Big Bear Creek

75–100 feet higher, the lowest strata seen are of Sub-Carboniferous age. There seems to be very little doubt that there is considerable difference of level between the two creeks mentioned, as the aneroid observations are confirmed by levelings made by railroad surveys.

In coming northward from Bull Mountain Creek P. O., the way is along ridges, averaging 150–200 feet in height above the water courses. Below the height of 200 feet, pebbles or angular fragments of chert are abundant, forming occasionally thick beds. Above that height none are found, the surface being usually sandy, with ferruginous sand rocks covering the tops and sides of hills. South of Burleson, on Big Bear Creek, the ridges are at least 250 feet above the waters of Bull Mountain Creek, and the surface soil a reddish sandy loam.

From Burleson downwards, Big Bear Creek cuts through strata of the Sub-Carboniferous formation chiefly. Above Burleson (up the creek), for several miles, appear the Sub-Carboniferous limestones, and beyond that, the sandstones, &c., of the Coal-Measures. Between Big and Little Bear creeks, is a high ridge elevated 225 feet or more above the former stream. The first 100 feet of this height seem to be made up mostly of the limestone and chert of Sub-Carboniferous age, and over that beds of Drift materials, angular chert pebbles below, sands and sandy loams above.

Little Bear Creek leaves the Coal-Measures a mile or two below the crossing of the Military road, and flows the rest of its course through Sub-Carboniferous and Drift beds.

The escarpment of Coal-Measures Sandstones, which forms so marked a feature in the southern part of the Valley of the Tennessee, as far west as Russellville, loses its importance west and southwest of that town, partly because of the diminished height of the escarpment itself, and partly because of the fact that beds of Drift have filled up the valley to the level of the top of this escarpment. Thus, for instance, if we start from Burleson, and travel eastward along the dividing ridge between Big and Little Bear creeks, we come upon the plateau of the Coal measures, without ascend-

ing any sudden elevation. The dividing ridge spoken of is made up chiefly of Drift beds, which are thus nearly at the level of the Coal-Measures, or slope gently up to them, hiding completely any escarpment that may have existed.

Between Nauvoo, southeast corner of section 17, township 7, range 13 west, and Russellville, the road is principally over limestone and chert, probably of the St. Louis group. The presence of large quantities of hydrated ferric oxide in the decayed masses of cherty limestone, is very noticeable, and in several localities it is found of sufficient purity to be a good ore of iron. This is particularly the case near the crossing of Cedar Creek southwest of Russellville, where formerly a Catalan forge was situated.

Near the crossing of Cedar Creek, a few miles west of Russellville, begins Russell's Valley, which stretches eastward, near the foot of the mountain past Russellville and Newburgh, into Lawrence county, where it takes the name of Moulton Valley.

The average width of the valley is perhaps five or six miles, and it is limited on the south by the mountain of Coal-Measures already spoken of, and on the north by thick deposits of gravel and sand, which cover the strata of the Mountain Limestone. The valley is a furrow cut down through the Mountain Limestone into the limestone of the St. Louis group, or Upper Siliceous.

Along this valley, pebble beds are not very common, whilst just north of it, they are, in places, one hundred feet in thickness.

Limonite is found in local accumulations, as ore banks from Cedar Creek to Newburgh, and the soil for this whole distance is colored deep red. A mile from Russellville, on the Courtland road, limonite ore banks, on Dr. Sevier's land, were examined.

Two samples of ore, from this locality, were analyzed by Mr. Henry McCalley, in the Laboratory of the Survey, with the results given below:

Analysis of oolitic limonite; color, dark brown; streak, brownish-red; locality, one mile east of Russellville, in Franklin county.

Specific gravity	3.616
Moisture (hygroscopic)	1.648
Combined water	10.444
Siliceous matter	3.159
Sesquioxide of iron	84.696
Alumina	.220
Oxide of manganese	.087
Lime	.440
Magnesia	.025
Phosphoric acid	.765
Sulphur	.054
	101.539
Metallic iron	59.287
Phosphorus	.334

Limonite, with smooth glazed surface, with outer shell of fibrous texture; exterior surface black; on fractured surface, liver brown; brittle and very hard; streak, dark brown; locality, one mile east of Russellville, Franklin county.

Specific gravity	3.800
Hygroscopic moisture	.833
Combined water	11.849
Siliceous matter	2.864
Sesquioxide of iron	83.514
Alumina	1.411
Oxide of manganese	.188
Lime	.407
Magnesia	.045
Phosphoric acid	.760
Sulphur	.085
	180.206
Metallic iron	58.459
Phosphorus	.332

Going south from Russellville, on the Tuscaloosa road, a hill of 175 feet elevation, is reached about one mile from the town. This hill is composed of the débris of chert beds, with much limonite, the soil a red colored sandy loam. South of this hill, the spurs of the Coal-Measures come down

within two miles of Russellville. Between these mountain spurs are limestone coves, often of several square miles area. The Tuscaloosa road reaches the foot of the mountain at the top of one of these coves, seven miles from Russellville. The section along this road, from Cedar Creek to top of the mountain, has already been given above.

Between Russellville and Frankfort, the road lies over ridges of angular chert pebbles. The water courses crossed are, in general, somewhat over 200 feet below the level of these pebbly ridges.

CHAPTER III.

Brown's Valley.

This includes parts of Jackson, Marshall, Cullman, and Blount Counties.

STRUCTURE OF THE VALLEY.

It is known to Geologists that after the deposition of the strata of the Carboniferous Formation, there followed a period of mountain making in the eastern part of North America. Amongst the most important results of the forces which came so prominently into play during this time, were the elevation of a wide belt running northeast and southwest, approximately parallel to the Atlantic coast, and the crushing together and wrinkling up of the strata of this belt, into folds having the same general northeast and southwest trend. The great folds or flexures thus impressed upon the face of the country, were of several kinds: some were simple folds; others were broken or fractured along the crest line; still others were fractured along this line, and the strata on one side of the line of fracture, were dropped down below the corresponding beds on the other side, thus producing what are known as *faults*. This elevated belt, with its folded and faulted strata, is a mountain chain known as the *Appalachian*, which extends from Pennsylvania into Alabama, where it terminates.

The clain is a complex one, made up of several distinct ranges: the Blue Ridge, the Alleghanies, and the Cumberland Mountains, naming them in order from east to west. The more prominent characteristics of the three mountain ranges above enumerated, may be given in a few words. The strata of the Blue Ridge have been folded and crushed together in the most complex way—and in addition, the rocks

have been changed into crystalline slates or schists, which are much harder and more resistant to denudation than the unchanged beds, so that in the Blue Ridge region we find rugged mountainous and broken country. I may say also that portions of the Blue Ridge were partially elevated before the period above mentioned at the close of the Carboniferous formation. The Blue Ridge is, in general, the watershed between the Atlantic and the Mississippi basin.

In the Alleghanies we find the rocks much less changed from their original condition, except along the western edge, though they are rarely found in horizontal beds; having been much folded, so that the strata all dip considerably. The upturned and outcropping edges of beds of different degrees of hardness impress themselves upon the scenery of this region, forming rocky ridges with beautiful valleys between.

The strata of the Cumberland region, or table land, are usually horizontal or very slightly inclined. This uniformity is interrupted in a few instances by long narrow folds, running parallel with the folds of the other two regions, and with the general direction of the Appalachian chain.

It is to one of these long folds in the Cumberland tableland to which we now direct the attention in speaking of Brown's Valley.

Beginning with the Crab Orchard Mountain in Morgan county, Tennessee, we may trace a fold of the rocks in a continuous line for a distance of 225 miles, nearly due southwest through Tennessee into Alabama, to its termination near the junction of the Big and Little Warriors, between Walker and Jefferson Counties.

The middle portion of this great fold, from the head of the Sequatchee valley in Tennessee to Reid's Gap in Alabama, has been broken or rent open along its summit, and along this rent or crack, water has excavated a valley 160 miles long and 5 or 6 miles wide, (Safford), called in Tennessee, Sequatchee Valley; in Alabama, Brown's Valley. The two ends of the fold have the strata *unbroken* along the crest line, thus forming ridges. The Tennessee end of this unbroken part of

the fold is called the Crab Orchard Mountain, the Alabama end has no distinctive name, but it is the ridge separating the waters of the two Warriors, and extending from Reid's Gap southwestward to near the point of confluence of the two rivers—a distance of twenty-five or thirty miles.

The Cumberland table-land has for its surface rocks the strata of the Coal Measures. Beneath these are the limestones, &c., of the Sub-Carboniferous, and other underlying formations.

All these strata are involved in the fold, and in that part where the valley has been excavated, the denuding waters have cut down into the limestones of the Sub-Carboniferous and in some places still deeper, into the lower Silurian formation.

Prof. Safford, in this connection says, "This fold, including its geographical and geological features, is beautifully symmetrical. It terminates at both ends in mountain ridges, these ridges sinking away with the two extremities of the fold. The denuded part, (Sequatchee valley being the northeastern end, and Brown's Valley the southwestern,) is a canoe-shaped, beautiful trough, in which are small characteristic ridges and valleys. This trough has a rim of Coal-Measures all around it."

The Coal-Measures which cap the high plateau separating Brown's Valley from the Basin of the Tennessee in North Alabama, appear nowhere to be very thick, so that none but the Lower Measures appear to be exposed in this area. The Conglomerate, which is near the bottom of the series, is the surface rock in places, from the Tennessee river west of Guntersville down to the center of Winston county.

This part, therefore, of the Warrior field might with propriety be considered as a part of the Cumberland Table-Land.

The seams of coal below this Conglomerate, two or three in number, are in Tennessee the most available for the production of coal. In Alabama, however, their thicknesses are quite variable.

In Alabama the geologically lowest rocks seen in the val-

ley, are the limestones of the Sub-Carboniferous formation, except at Blount Springs, near Scottsboro, Stevenson, and in a few other localities where the underlying Silurian rocks are exposed, over small areas.

DETAILS.

The geological relations of the counties through which the valley extends are quite simple. The lower strata of the Coal-Measures, including several seams of coal, form the surface over the whole area, except where removed by denudation, 1st, in Brown's Valley, and 2d, in the subordinate valleys or coves which have been cut by small streams, back into the rim of Coal-Measures which bounds Brown's Valley on each side.

In Blount and Marshall counties, the edges of the valley are very slightly indented, and the same is true of the eastern edge in Jackson, but the western rim in the last named county, is so deeply gapped by coves which extend back for many miles, that the symmetry of the valley is almost lost.

Just above Stevenson the railroad passes near the foot of one of the mountain spurs which bound the valley on the west. The slopes of this mountain are formed of the limestones of the Chester or Mountain Limestone Group.

Near the summit of the mountain and beneath a bed of sandstone or conglomerate, which forms a series of cliffs around the mountain, is a seam of coal which has been worked in two or three places.

For the purpose of giving a fair presentation of the measures, as exposed upon the mountain spurs west of the Tennessee river valley in Jackson, I will add here a section made by Dr. James M. Safford in the valley of Crow Creek, near Anderson Depot on the Nashville & Chattanooga road, and near the Alabama line:

(12.)	CONGLOMERATE, coming in back of the top of the cliff formed by the sandstone below.	
(11.)	COAL *and shale;* coal so far as seen only eight or ten inches.....	40 feet.

(10.) SANDSTONE, heavy, makes the *cliff*: thickness (estimated)..... 120 feet.
(9.) COAL, from 2 to 5 feet of lustrous, black, good coal, more or less laminated by thin leaves of mineral charcoal; contains some pyrite occasionally in seams. The coal will perhaps average..... 3 feet.
(8.) FIRE CLAY..... 3 "
(7.) SHALE..... 8 "
(6.) SANDSTONE..... 10 "
(5.) COAL? *and shale*..... 10 "
(4.) SANDSTONE *and Sandy Shale*..... 55 "
(3.) Shale.....1 to 6 "
(2.) COAL, has been opened, a laminated, cubic coal, without pyrite, will average, so far as seen, from.....$2\frac{1}{2}$ to 3 "
(1.) *Shale*, with clay iron stones, followed below by rocks not seen.

In this connection Prof. Safford says, "The second coal below the conglomerate (bed 9), has been and perhaps is now worked at several points below Anderson. Its average thickness is considerably less than three feet. Occasionally it is above this, and at one point in Alabama, not far below the Tennesse line, it measured *seven* feet, soon, however, running down to two."

Further southwest, in the vicinity of Larkinsville, the measures have been pretty thoroughly tested with the diamond Drill, by Messrs. DeBardeleben & Co. These drillings show that the seam is extremely variable in thickness.

The floor of the valley in Jackson county is mostly formed by the strata of the lower or Siliceous division of the Sub-Carboniferous formation. In the coves between the spurs of the Cumberland Mountains the St. Louis Limestone is the principal surface rock, whilst in the immediate valley of the Tennessee (Brown's or Sequatchee valley) the lower group of the Siliceous division is seen, and, in places, even the underlying Black Shale and Silurian rocks are exposed.

Near Stevenson, as is also the case beyond Guntersville to the end of the valley at Reid's gap, a ridge composed prin-

cipally of chert divides the valley longitudinally into two parts. Upon this ridge, everywhere, limonite is found, which occasionally is pure enough and in sufficiently large quantity to constitute valuable ore-banks.

Generally, however, the limonite is too much mingled with chert, in all stages of decay, to be of much value.

In section 31, township 1, range 3, are occurrences of fossiliferous limestones of greenish and reddish colors. These, when worked up, take a fairly good polish, and might well be used for mantles and other articles of the kind.

Near Warrenton the western rim of the valley is formed in great measure of a conglomerate, a mass of quartz grains cemented together, and enclosing rounded pebbles of white quartz, about the size of peas. Above the conglomerate are sandstones and shales of the usual character, and below it, first, shales and sandstones with one or two thin coal seams, and then the shaly and cherty limestones of the Sub-Carboniferous Formation.

Near Guntersville the eastern rim of the valley is Sand Mountain, which, like the rim on the western side, is made up of the Sub-Carboniferous limestones below, and the conglomerate, sandstones and shales of the Coal-Measures above. On both sides, the strata of the Coal-Measures lie in nearly horizontal position, with a slight dip *away* from the valley, forming in this way a table land or plateau.

In the following descriptions, it will be convenient to divide the valley between Guntersville and Reid's Gap into two halves, the one extending from Guntersville to within 6 or 8 miles of Blountsville, and the other from the latter point to Reid's Gap. At the point indicated, there is a divide between the waters flowing northeast into the Tennessee, and those flowing southwest into the Warrior. At this dividing line the surface rocks are sandstones, either of the upper part of the Sub-Carboniferous formation, or of the lower Coal-Measures. The height of the water shed (where the road crosses it), above the river at Guntersville, is not less than 375 feet.

Near this point two creeks, flowing northeast, have their sources—Brown's Creek on the west, Gunter's Creek on the east. They flow parallel to each other and about one and a half miles apart, into the Tennessee. A ridge of chert, the débris of the cherty limestones which form the general floor of the anticlinal valley, separates the two creeks and the two valleys through which they flow. It is worthy of remark that in the anticlinal valleys further southeast, particularly Murphree's and Jones' valleys, chert ridges formed of débris of *lower Silurian* cherty limestones, divide those valleys in the same way, and the chert ridge in Jones' valley certainly, and perhaps in Murphree's valley also, follows the line of a *fault.*

In Gunter's valley, the cherty limestones of the Lower or Siliceous Group of the Sub-Carboniferous formation make the greater part of the surface. The Mountain Limestone is confined to the slopes of the Sand Mountain. It seems hardly possible to make out in this valley the subdivisions of the Siliceous Group. From the occurrence, however, of numerous sink holes and big springs, it seems probable that the St. Louis limestone is the principal surface rock.

The prevailing soil in Gunter's Creek valley, is of deep red color, and fertile; along the sides of the chert ridge and near the head of the valley, the soil is more sandy, gray in color, and less fertile.

Southwest of Brooksville, beyond the transverse dividing ridge alluded to above, the drainage is southwest into the two Warriors, a chert ridge dividing the valley longitudinally into two parts. Blountsville lies on the northwestern side of this chert ridge, and the valley at this place is quite narrow. Below Blountsville the ridge rises to a considerable height, and there are several peaks which, according to the measurements of the United States Coast Survey, attain an altitude above the sea of more than 1200 feet.

CHAPTER IV.

THE WARRIOR COAL FIELD.

Including under this head all the Coal Measures of Alabama, drained by both forks of the Warrior and their tributaries, the Warrior Coal Field may, for convenience, be divided into two parts—the *Plateaus or Table Lands*, and the *Warrior Basin* proper.

The *Table Lands* may be again subdivided into two parts; the one lying between the Great Sequatchee fold (Brown's Valley) and the limestone valleys of North Alabama, and including parts of the counties of Marshall, Morgan, Blount, nearly all of Cullman, and the eastern half of Winston, with perhaps a small portion of the north-east quarter of Walker; the other, between Brown's and Wills' Valleys, comprising the coal areas on each side of Murphree's Valley, and including parts of the counties of Marshall, Blount and Jefferson. These may with propriety be considered as extensions into Alabama of the Great Cumberland Table Lands and Walden's Ridge of Tennessee.

The height of these Plateaus diminishes continuously towards the south-west, the Plateaus passing gradually into the Basin proper. In Tennessee the elevation of the Plateau above the surrounding county varies from 850 to 1000 feet. In Jackson and Madison counties some of the spurs attain an equal height, but further southwest in Morgan and Marshall, the elevation will average not more than 550, and in Cullman and Blount counties not more than 300 feet above the general level of the country.

It is characteristic of the Plateaus that the limestone beds which underlie the capping of Coal Measures rocks, are *above* the general drainage level of the country. This arrangement of the two classes of strata determines in great measure the character of the scenery, for the removal by erosion of

the more perishable limestones, causes the undermining of the harder sandstones above, which from time to time, break off with vertical faces, forming cliffs. From the same circumstance, the streams flowing out into the valley towards the west and north, have cut back into the tablelands, deep coves, the length of which depends, amongst other things, upon the thickness of the limestones above the drainage level. For this reason, the length of the coves diminishes towards the south-west. The Plateaus are nowhere cut entirely through by streams, except by the Tennessee below Guntersville.

The rim or margin of the table lands is generally only slightly indented by the streams, except on the western edge in Jackson and Madison, and on the northern edge facing the Tennessee valley in Morgan, Lawrence, and Franklin counties. The outline especially in Jackson and Madison counties of this western face of the Plateau is extremely jagged and irregular.

Of the character and extent of the coal seams occurring upon the Plateaus, something has already been said above, under Madison, Morgan and Marshall counties. The coal seams are all of the lower series, amongst them, one or two of workable thickness. Near Stevenson, Larkinsville, Huntsville, Oleander, on Short Creek, and at a few other localities, one or the other of these seams has been worked on a small scale, and there can be no doubt that further examinations will bring to light other localities when the thickness of the coal will allow it to be worked with profit.

At present, however, lack of means of transportation stands in the way of the working of these beds except in a few localities. The position of the seams, high above the water level of the country is favorable to mining.

The *Warrior Basin*, includes parts of Jefferson, Tuscaloosa, Walker, Winston, Marion and Fayette counties, drained by the Warrior. Tributaries of the Tombigbee, however, drain part of this area in Fayette and Marion counties, and a

small tract in contiguous corners of Marion, Winston, and Franklin counties, is drained by Big Bear Creek into the Tennessee. The average elevation of the land above the principal water courses is from 200 to 250 feet, the height above sea level it is not possible at present to give.

From the facts that the measures sink gradually towards the south and west, and that the Sub-Carboniferous limestones in these directions, not only sink below the general surface, but actually thin out, as is seen in the section exposed in the anticlinal valleys, Jones', Roup's, &c., it is evident that no sharp line of division can be drawn between the Table lands and the Basin. For convenience we may assume, (provisionally at least) that the Table land extends south nad west as far as the lower conglomerate appears as a surface rock, and where none but the lowest seams of the Coal Measures are exposed. This would class the measures of Blount, Cullman, and the northeastern parts of Jefferson and Winston with the *Table lands*, and south and west of these limits would be the *Basin* proper.

As Brown's Valley divides the Plateau into two parts, so the continuation of the valley as an anticlinal fold for twenty-five or thirty miles south-west of Reid's Gap, divides the Basin into two unequal parts. South-west of the confluence of the Warriors these two parts seem to come together in one common basin, by the sinking away of the anticlinal fold which separates them higher up.

Our knowledge of the Warrior Basin is quite limited; the narrow belt lying between the Warrior River and Jones' Valley in the northwestern part of Jefferson county, is the only portion about which these is any reliable information concerning the number of coal seams, their thicknesses, and their relations to the interstratified rocks, and this part of the field has been systematically explored only along the line of the South and North Alabama Railroad, and west of Birmingham.

In Tuscaloosa county, near the Alabama Great Southern Railroad, Coal has been mined in several localities; so, also, near the town of Tuscaloosa.

The northwestern part of the basin, including Walker, Winston, Fayette and Marion counties, is, so far as a knowledge of the Coal Measures goes, practically a *terra incognita.*

Railroad surveys have been carried through this region, and incidentally the outcrops of coal seams near the lines of the surveys have been noticed. A geological reconnoissance has been made through the counties named, and occurrences of coal noted; partial explorations in the interests of companies and of individuals have been made, but the data thus collected are neither sufficiently numerous nor sufficiently connected to be used in the construction of a reliable geological section of that part of the field. A proper exploration of this area would require the expenditure of a large amount of money and several years work.

In this report I shall endeavor to give as well as possible the present state of our knowledge of this basin, and since it is not possible to give a general description of the entire field, I shall give merely some details of the counties included in this area.

JEFFERSON COUNTY.

In a former report, I published the results obtained by boring with the diamond drill, at several localities in the southeastern part of the Warrior field, along the line of the S. & N. Ala. R. R., and in the vicinity (west) of Birmingham.

The labors of Mr. T. H. Aldrich, to whom I am indebted for the facts given below, have brought to light the connections between these drillings, and have rendered possible the construction of a section of this part of the Warrior field, which is approximately correct.

A section from Jones' Valley, above Birmingham, to Brown's Valley, along the line of the S. & N. Ala. R. R., includes that part of the Warrior field which has been most extensively worked for coal, and which is therefore best known. This section, as showing the geological relations of the strata of Jones' and Brown's Valley, as well as those of the Coal-Measures, is an instructive one.

Jones' Valley, as has been mentioned in previous reports, is divided longitudinally by a ridge made up of chert fragments, the débris of the cherty limestones of the Knox Dolomite or Quebec formation of the Lower Silurian. This ridge, for a part at least of its length, marks the position of a fault by which Upper and Lower Silurian are brought into contact.

A reference to the map published in my report for 1876, will show that the Clinton group of Upper Silurian, and, in some instances, the Black Shale, and even the Sub-Carboniferous limestone, have been involved in the faulting, and brought up the level of the Quebec Dolomite, in the valley below Elyton. The same condition of things obtains further north above Birmingham, and the line of fault is there also marked by the chert ridge.

West of this ridge, the strata have been overlapped, so that they all dip one way, *i. e.* southeast; but the newer formations lie *beneath* the older. In crossing the western part of the valley, therefore, going towards the Warrior field, we pass over the upturned edges of the strata (all dipping southeast) of the formations, in the following order:

	Lower Silurian	(1) Quebec or Knox Dolomite with chert. (2) Chazy and Trenton limestones.
	Upper Silurian.	(3) Clinton Sandstones and Red Hematite Ore.
Sub-Carboniferous.	*St. L. Limestone, etc.*	(4) Sub-Carboniferous cherty limestones, &c.
	Chester Group	(5) Heavy bedded sandstone, siliceous, glist'ng in the sun. (6) Limest'ne with *Pentremites* and other Sub-Carb. fossils.
	Coal Measures.	(7) Shales. (8) Heavy bedded siliceous, glisten'g sandstone, in nearly vertical ledges, forming the high rocks on each side of the railroad at Boyles' Gap. (9) Shales and sandstones of the Warrior basin.

A moment's reflection will show that, with southeast dips, the formations are reversed, so that the Quebec overlies the Chazy and Trenton formations, and these in turn, the Clinton and Sub-Carboniferous.

The beds of limestone, No. 2, may be traced for a long way up and down the valley, where their up-turned edges, in many places, form a series of low walls, running northeast and southwest. No. 3, at this place, is not well shown, but south of the railroad the red ore becomes much more conspicuous.

No. 4 (the Siliceous group), also near the railroad not very well shown, though easily recognizable. Further south, Nos. 3 and 4, with the Black Shale between them, form a conspic-

uous ridge, the counterpart of the Red Mountain ridge on the other side of the valley. No. 5, from its position, is, with very little doubt, to be referred to the Mountain Limestone or Chester Group. It is probably the representative of that sandstone layer in the Mountain Limestone which, in North Alabama, plays so conspicuous a part in the scenery. (See further details under Franklin and Lawrence counties.)

No. 6, also a member of the Chester or Mountain Limestone group, is well shown in the low places on each side of the railroad.

The remainder of the section, Nos. 7 and 8, may probably be referred with No. 9 of the Coal-Measures.

The heavy bedded siliceous sandstone, No. 8, has usually been called (adopting Prof. Tuomey's nomenclature), Millstone Grit. It rises in nearly vertical ledges, forming a conspicuous ridge on the western side of the valley down to its termination southeast of Tuscaloosa.

It is everywhere, in the anticlinals of Middle Alabama, found near the base of the Coal-Measures; but in the northern part of the State, it is often much less conspicuous. It seems probable that the line between the Mountain Limestone and the Coal-Measures, should be drawn between No. 6 and No. 7 of above section.

The thickness of the sandstone No. 5, is about 60 feet, and the dip 28° to southeast.

The limestone, No. 6, with shales No. 7, are together 75 feet thick. The siliceous sandstone, No. 8, is 120 feet in thickness, and dips 45° to southeast.

Continuing, now, the section along the railroad, *inside* of the rim of sandstone which makes Boyles' Gap, we find the usual sandstones and shales of the Coal-Measures. These beds, for a distance of 1,000 feet or more across the strike, show evidences of great disturbance, dipping at high angles, the prevailing dip being southeast. Within these nearly vertical measures, which include one or two seams of coal, there is a sharp anticlinal fold, the strata on both sides being nearly perpendicular. On the western edge of this nar-

row strip of highly inclined strata, is a *fault*, beyond which begins the great basin of this part of the field. Immediately beyond this fault, the measures dip 35° *northwest*, falling off within a few hundred feet, to a dip of 13°.—(Aldrich.)

The rest of the section, across the field to Reid's Gap, I take from an article written for Berney's Hand Book of Alabama, the notes for which section were kindly furnished to me by Mr. Aldrich.

"The railroad, after entering the basin, follows very nearly the line of the strike of the strata for about two miles, the dip being from 8° to 15° northwest throughout this distance; then a fold in the rocks brings to the surface the 'Warrior,' 'Black Creek,' and the 'Jefferson' seams of coal.

The openings of the Coalburg Mining Company, Thos. Sharp, Superintendent, are situated near centre of S. 30, T. 16, R. 2, W. The slope is about 350 feet deep (1877) and is sunk upon the Black Creek seam, though some doubt seems to exist here as to which seam should bear the name of Black Creek.

The section in the vicinity of the slope would be as follows:

(11.)	Shale and Sandstones	75 ft.	00 ins.	
(10.)	Coal (bands of Slate)	00 "	20 "	
(9.)	Slate, etc	40 "	00 "	
(8.)	Coal	00 "	12 "	} *Jefferson Seam.*
(7.)	Slate	00 "	10 "	
(6.)	Coal	00 "	12 "	
(5.)	Sandstone	14 "	00 "	
(4.)	Coal, good	00 "	16 "	*Unknown Seam.*
(3.)	Slates and Sandstones	35 "	00 "	
(2.)	Coal	19 "	24 "	*Black Creek Seam.*
(1.)	Sandstones, &c.			

The slope at Coalburg starts at a dip of about 35°, and soon falls off to the very low one of 8°."

"The railroad continues still nearly on the strike of the strata, for three miles, to Newcastle Station, where the mines of the Newcastle Company, Jno. T. Milner, Superintendent, are situated.

A section of the measures at this point, compiled from borings and other data, is nearly as follows, beginning above:

Coal	5 ft.	8 ins.	*Newcastle Seam.*
Sandstones, &c.	15 "	0 "	
Coal	0 "	22 "	
Fire Clay	3 "	0 "	
Sandstones, &c.	20 "	0 "	
Coal	2 "	6 "	
Sandstones, &c	25 "	0 "	
Black Band Iron Ore	1 "	4 "	
Sandstones, &c.	20 "	0 "	
Coal	4 "	9 "	
Sandstones, &c.	25 "	0 "	
Conglomerate	16 "	0 "	
Sandstones, &c	130 "	0 "	
Coal	0 "	18 "	
Sandstones, &c.	50 "	0 "	
Coal, (slate in the middle).	2 "	2 "	*Jefferson Seam.*
Sandstones, &c.	9 "	0 "	
Coal	1 "	6 "	
Sandstones, &c.	4 "	0 "	
Coal	0 "	9 "	
Sandstone	50 "	0 "	
Coal	2 "	4 "	*Black Creek Seam.*
Sandstones, &c.			

The Newcastle seam may be seen outcropping on the west side of the little valley; the dip is about 5° to northwest.

An analysis of coal from this seam may be found in my Report for 1875, pages 39 and 63, together with details concerning the mine. When washed, this coal makes an excellent coke, but on account of the shale in the seam it is not now worked; the underlying Black Creek seam is the one from which coal is now raised at Newcastle. This seam is reached from the railroad, by a tramway 1200 feet in length. The average thickness of the seam is 32 to 33 inches, and the dip like that of the Newcastle seam, 5° to northwest. The seam is underlaid by fire clay; the roof is also clay, and is noted for the beautiful fern impressions contained in it.

Analysis of Black Creek Coal, by PROF. N. T. LUPTON.

Specific gravity	1.29
Moisture	1.36
Volatile Matter	31.79
Fixed Carbon	64.71
Ash	1.82
Sulphur	.32

The evaporating power of the coal, from experiments made in Louisville, Ky., is 8.01 lbs. of water to the pound of coal. As a gas coal it is excellent. A statement from Geo. H. Wells, of Nashville, now before me, shows that it yields 4.82 cubic feet of gas per pound of coal, and 33⅓ bushels of screened coke per ton. The output of the mines is 100 tons per day.

The seam of black band iron ore seen in the above section is worthy of notice. It outcrops close to the railroad, a short distance north of the station."

"A quarter of a mile above Newcastle Station, there is a great fault, 800 feet or more in width, and having an east and west direction. Nothing is known of the relations of this fault to the great field, except that it has been traced several miles from the road.

Crossing this fault, we are in the central part of the basin. The rocks here are perfectly horizontal for several miles, and no developments have been made."

"At Jefferson Mines, 10 miles above Newcastle Station, is the shaft of the Jefferson Coal Company, Marshall Morris, Superintendent. This shaft is 200 feet in depth, starting above the conglomerate (of the foregoing section,) and passing through the Jefferson down to the Black Creek seam. A section of the shaft is about as follows:

COAL, poor, full of slate	4 ft. 9 in.
Clays and sands	21 " 1 "

Conglomerate	16 "	0 "	
Slate.....	1 "	0 "	
Coal, with shale.....	1 "	6 "	
Sandstones, clay, and shales.	81 "	10 "	
Coal, good, hard.....	1 "	6 "	
Sandstones	40 "	6 "	
Coal, good.....	3 "	3 "	*Jefferson Seam.*
Sandstones, &c.....	29 "	5 "	
Coal, good.....	2 "	6 "	*Black Creek Seam.*
Sandstones.....			

The *Jefferson seam* in this shaft, shows a thickness of about 40 inches, and has a good roof.

The *Black Creek seam* is more irregular, running from two and one-half to three and one-half feet, but has no shale partings, and is said to be at this point the best iron making coal yet found on the road.

The Eureka Company is using a considerable quantity of this coal in the furnaces at Oxmoor."

" Half a mile north of this mine, the Warrior river is crossed by the railroad, and beyond the river, begins the northwest side or edge of the basin. Here the measures rise about two feet in one hundred, up to Warrior station, four miles north of the river.

At this point the Warrior seam is extensively worked by Mr. Jas. T. Pierce, and by the lessees of the Alabama Mining and Manufacturing Company, Mr. Frank Hoene, Superintendent.

The section at this point, as given by borings, is :

Sandstones and clays with fossils.	85 ft.	6 in.	
Coal	1 "	2 "	
Cannel Coal and Black Band....	2 "	4 "	
Slate, hard	4 "	0 "	
Coal, average thickness.....	2 "	9 "	*Warrior Seam.*
Clays, sandstones, &c			

The strata under the Warrior seam, are given below in the general section of the field, as compiled from borings.

The seam dips very slightly, and drifts are run in all along

the outcrop. The coal is excellent, and is used on the engines of the S. & N. Ala. R. R.

Mr. Jas. T. Pierce works one shaft with capacity of 100 tons a day, and four slopes capable of an output of 150 tons a day.

The Alabama Mining and Manufacturing Company, Mr. Hoene, Superintendent, work three openings with one main entry, and several east and west entries. Capacity of the mines, 120 to 150 tons per day. From the mouth of the entry the coal is hauled by steam power up an incline, and thence by a tramway one-eighth of a mile long to the weighing house; it is then dumped directly upon the cars of the S. & N. Ala. R. R., near the station.

The coal enjoys an excellent reputation, especially for domestic and steam purposes. The seam averages about three feet in thickness, the dip about 18 in 100 to southeast. Roof, hard slate about four feet thick, above which is the stratum of black band and coal, two feet six inches thick Above the black band is sandstone. Below the coal is fireclay, four feet thick, the first foot gritty, the rest good clay."

"Going north of Pierce's station, where the outcrops of the Warrior seam rise to the surface, we cross a long series of sandstones and shales to Reid's gap, where the glistening siliceous sandstone, often called millstone grit, and the other accompanying strata are repeated, and we come then to the valley of Blount Springs (Brown's valley)."

In the foregoing sections, the Newcastle is the topmost seam.

Recent researches of Mr. T. H. Aldrich have shown that southwest of the S. & N. Ala. R. R. a series of coal seams comes in above the Newcastle, and he has worked out the relations of these seams so that it is possible to give an approximately accurate section of the Warrior Basin in this part of the State.

If we refer back to the descriptive section along the S. & N. R. R., it will be seen that inside of the ridge of siliceous sandstone through which the railroad passes into the Coal

Measures at Boyle's Gap, the measures show evidences of having been much faulted—they stand nearly vertical in some places—and about 1,000–1,500 feet northwest of this ridge across the strike, occurs a fault beyond which the measures are nearly horizontal, being slightly upturned near the edge of the fault.

Southwestward this fault does not appear to run parallel with with the edge of the Coal Field, but makes an acute angle with it, so that if its direction continued the same, it would intersect the edge of the Coal Field, perhaps eight or ten miles southwest from Boyle's Gap, the strip of faulted measures thinning out between.

Along the S. & N. Ala. R. R. the strata of the great basin dip northwestward, but a few miles further south, the dip changes slightly more to westward, and the series of upper seams comes in. These upper seams appear to lie in a sort of basin, for their outcrops, instead of running parallel with the edge of the Field, bear away towards the north and west. The limits of the basin and the area underlaid by these upper seams, are not yet made out, except in the immediate neighborhood of the Pratt Mines, and thence southward.

In the north half of northeast quarter of S. 30, T. 17, R. 3, west, the PRATT COAL & COKE COMPANY have sunk a slope upon what is known further to the southwest as the Brown seam. The section of this seam is as follows:

Top	Slate.
COAL	10 inches.
Slate	2 "
COAL	46 "
Slate	

The coals from both benches of this seam, together with the two inches of slate between, have been analyzed by Mr. Henry McCalley, in the Laboratory of the Survey. The results are as follows:

1. Analysis of average sample of coal from upper bench of Pratt Coal and Coke Compdny's Seam.

Specific gravity	1.33
Sulphur	1.224
Moisture	1.474
Volatile Combustible Matter	32.288
Fixed Carbon	59.503
Ash	6.735
	100.000

2. Analysis of average sample of coal from lower bench of Pratt Coal and Coke Company's Seam.

Specific gravity	1.278
Sulphur	.612
Moisture	1.529
Volatile Matter	30.683
Fixed Carbon	63.683
Ash	4.102
	100.00

3. Analysis of the slate parting between upper and lower benches of Pratt Coal and Coke Company's Seam.

Proximate Analysis.

Specific gravity	1.988
Moisture	1.621
Volatile Matter	11.719
Fixed Carbon	23.839
Ash	62.821
	100.00

Analysis of the Ash of above Slate.

Silicic Acid	63.155
Ferric oxide	6.383
Alumina	22.884
Lime	.703
Magnesia	.536

Potash	2.164
Soda	1.143
Phosphoric Acid	2.564
Sulphuric Acid	.145
Sulphur, combined	.051
Chlorine	Trace.
	99.728

The dip of the seam at the slope is $4\frac{1}{2}°$ to the northwest, but northeast of the mine the dip of the seam changes more and more towards the west, and the line of outcrop, at the same time, turns from northeast towards the north, showing the edge of the basin.

The improvements at the mine are, a shoot 140 feet long, with tracks for each grade of coal.

A double hoisting engine, of 40 horse power.

Two hoistways and manway in slope.

Fifty coke ovens 12 feet in diameter, now building. It is proposed to build 150 in all.

Daily output at present, 206 tons; capacity of the mine, 500 tons per day.

I give below a general section of the Warrior basin in this locality. For the section, from the top down to the Newcastle seam, I am wholly indebted to the kindness of Mr. T. H. Aldrich, who has carefully explored this part of the field, and made out the relations between the upper and lower series.

From the Newcastle seam downwards, the section is compiled from borings, made with the diamond drill; in various parts of the field, and especially from examinations made along the South & North Alabama R. R. For this, also, I am in great measure indebted to Mr. Aldrich.

This is probably as near an approach to an accurate section of the Warrior basin, southeast of the Brown's Valley Anticlinal, as can be made with the data at present available.

General Section of the Warrior Basin, west of Birmingham, Jefferson County.

Surface soil, of variable depth				
Coal, *Guide Seam*	0	feet,	3	in.
Sandstones, shales, &c	115	"	0	"
Coal, *Pratt Seam*	4	"	8	"
Sandstones, &c	20	"	0	"
Coal, *Sixteen Inch Seam*	1	"	4	"
Sandstones, shales, &c	30	"	0	"
Coal	2	"	4	"
Sandstones, &c	5	"	0	"
Coal, *Four Foot Seam*, in two benches of equal thickness, with 8 inch slate parting	4	"	8	"
Sandstones, shales, &c	50	"	0	"
Coal, *Quadruple Seam*	6 or 7	"	0	"
Sandstones, and other measures	20 to 30	"	0	"
Coal, *Slaty Seam*	1	"	6	"
Sandstones, &c	35	"	0	"
Coal, slaty, one bench 2 feet thick	8	"	0	"
Sandstones, &c	100	"	0	"
Coal, *Double Seam*, two seams 8 in. and 15 in., with 5 feet of shale, &c., between	7	"	0	"
Sandstones, &c	100	"	0	"
Shales	25	"	0	"
Coal, good	4	"	6	"
Sandstones, &c	25 to 30	"	0	"
Coal, small seam	1 to 2	"	..	"
Shales, &c	6 to 10	"	0	"
Coal, in two benches of 3 and 15 inches, with 2–3 feet of slate between	4	"	0	"
Sandstones, &c	100	"	0	"
Coal	2	"	2	"
Shales, and other measures	50	"	0	"
Coal, double seam, thickness not known.				
Sandstones, shales, &c	300	"	0	"
Coal, *Newcastle Seam* (slaty)	5 ft. 8 in. to 6	"	3	"
Sandstones, &c	15	"	0	"
Coal, poor	1	"	10	"
Fire clay 3 feet, and sandstones 20 feet	23	"	0	"
Coal	2	"	6	"
Sandstones, &c	25	"	0	"
Black band Iron Ore	1	"	4	"
Sandstones	20	"	0	"
Coal, poor, full of slate	4	"	9	"
Fire clay and arenaceous clays	20–30	"	0	"

Conglomerate	16–20	"	0 "
Coal, with shale	1	"	6 "
Sandstones, shales, &c.	81	"	10 "
Coal, good, hard	1	"	6 "
Sandstones	40	"	6 "
Coal, good, *Jefferson Seam*	3	"	3 "
Sandstones, &c	29	"	5 "
Coal, good, *Black Creek Seam*	2	"	6 "
Sandstones, &c	139	"	0 "
Coal, doubtful	1	"	6 "
Sandstone, with fossil shells	85	"	0 "
Coal	1	"	2 "
Sandstones, &c	30	"	0 "
Cannel Coal and Black Band	2	"	4 "
Slate, hard	4	"	0 "
Coal, good, *Warrior Seam*	2	"	9 "
Clays, sands, &c	20	"	5 "
Coal	1	"	8 "
Clay and sandstone	7	"	6 "
Coal, hard	2	"	2 "
Shale, sandstone, &c	295	"	6 "
Coal, hard and bright	1	"	6 "
Sandstone and fire clay	17	"	0 "
Coal	1	"	4 "
Shales, with coal plants	12	"	0 "
Coal, good	2	"	6 "
Sandstones, clays, &c	102	"	7 "
Shales and sandstones, with two thin seams of coal near bottom of series	450	"	0 "
Siliceous Sandstone, base of Coal Measures	100	"	0 "
Sub-Carboniferous: Shales	80	"	0 "
Sub-Carboniferous: Limestone, with *Pentremites*	75	"	0 "
Sub-Carboniferous: Siliceous Sandstone	60	"	0 "

TUSCALOOSA COUNTY.

Although coal has been mined in the vicinity of Tuscaloosa for many years, there has been no systematic exploration of the Coal-Measures of the county.

Under the auspices of the Tuscaloosa Mining and Manufacturing Company, a number of sections of coal seams were made in several places on the tributaries of Davis', Daniels', and Hurricane Creeks. It may be of interest to give some of these sections, as illustrating the character of the coal beds eighteen or twenty miles northeast of Tuscaloosa.

Together with these measurements I will give those of beds in other localities where coal has been dug for local use.

In S. 5, T. 21, R. 7, W., near the center of the section, and on land belonging to Mr. Martin Williams, a thin seam of coal, 10 inches thick, has been worked to supply the forges of the vicinity.

In the NW of NE of S. 8, adjoining, another opening, upon what may be the same seam, the thickness, however, being a little greater, 12–13 inches.

Also, in the SE of NW of S. 9, same township and range, is another bed, 25–30 feet above the two just named. The coal here is said to be 16 to 18 inches thick, a good hard coal.

Upon a tributary of Little Hurricane Creek, in S. 1, T. 21, R. 8, W., there are three beds separated by 25–30 feet of intervening strata; the uppermost of these is called the Lawrence bed—said to be about 3 feet thick; 25 feet below this, the Ball bed, thickness not determined; and 25–30 feet lower, the Phelan bed, 3 feet thick, lying under a conglomerate.

In the same section, on J. D. Hamer's land, an outcrop of coal was seen, about 3 feet in thickness, with some shale.

In section 2, on Mr. Peterson's and on Mrs. L. C. Garland's land, a seam of about the same thickness has been worked; perhaps the same bed. The bed at Hamer's has immediately over it four feet of fire-clay, and over the clay a conglomerate, of which four or five feet are exposed. The Peterson bed has over it, also, fire-clay overlaid with conglomerate.

This bed shows very little shale, almost none, and the coal is 27½ inches in thickness. The Garland bed, S. 2, T. 21, R. 8, W., is probably the same.

North of these localities, in T. 20, R. 8, W., are also several beds where coal in small quantities has been mined. In the NW of SE of S. 36. T. 20, R. 8, W., a bed 18–24 inches thick has been worked by Mr. Toxey; the quality of the coal is good, and the roof is of sandstone.

In the NE of NW of S. 35, adjoining, a bed 2 feet thick has been opened, and in SW of SE of S. 26, like the preceding, on land belonging to Mrs. L. C. Garland, another bed, showing about 3 feet of coal, has been opened and worked. This coal enjoys an excellent reputation, having been mined here and sold in Tuscaloosa. This is sometimes called the Mallett bed, and it is separated from the bed in S. 35, above mentioned, by 30 feet of Measures.

East of these openings, others have been made in Township 20, Range 7.

In the northeast corner of section 9 of this township, and in southwest corner of section 18, two outcrops have been accurately measured. The first is called *Burchfield No. 1*, the other the *Haldman bed;* from the similarity of the two sections it seems probable that the bed is the same:

	No. 1.	No. 2.
Sandstone Roof	.....	.....
Coal	13 inches.	17 inches.
Slate	3 "	2 "
Coal	9 "	9½ "
Slate	2 "	1½ "
Coal	7½ "	10 "
Slate	2½ "	½ "
Coal	15 "	12 "
Fireclay	22 "	36 "
Coal	19 "	28 "
Fireclay	.....	.....

In section 19 of same township, the following measurements were made:

Surface	.....	Burchfied No. 3.
Coal	1 foot 3 inches.	
Shale	0 " ½ "	
Coal	0 " 6 "	
Shale	0 " 1 "	
Coal	1 " 7½ "	
Fireclay	not determined.	
Sandstones, &c.	20 feet 4 inches.	
Coal	2 " 4 "	Burchfield No. 2.
Fireclay	.....	

These two beds have been called *Burchfield beds No. 2 and 3.*

In the southeast corner of section 30, same township, we get the following section of what is called the *Jones bed:*

Roof—shales	.....
Coal	0 feet 9 inches.
Shale	0 " 7 "
Coal	0 " 10 "
Fireclay	3 " 6 "
Coal	1 " 7 "
Shale	0 " ½ "
Coal	0 " 11 "
Shale	0 " 1 "
Coal	1 " 3 "
Fireclay	.....

In section 27, township 20, range 7, east of the foregoing

outcrop, the following measurements were made of what is called the *Hart bed:*

Sandstone Roof.....			
Coal.....1	foot	8	inches.
Slate.....0	"	1	"
Coal.....0	"	7½	"
Slate.....0	"	1	"
Coal.....0	"	9	"

Some distance down the branch from this outcrop, another bed has been exposed, which was measured as follows, *Thomas bed:*

Sandstone Roof.....			
Coal..... 1	foot	7½	inches.
Slate..... 0	"	1	"
Coal..... 1	"	1	"
Fireclay.....			

About 15 feet below this, and separated from it by shales, is a small seam 2–4 inches in thickness.

On Brushy Creek, several small seams have been observed, which lie between the beds above given and the Warrior river level.

It is, of course, not possible to give with certainty a section of the strata as exposed in this part of the county, but as any attempt to reduce to order, the various observations already made, is worthy of attention, I make no apology for introducing here, a section which was constructed by Mr. Bowen, of Pennsylvania, whilst exploring in the interest of the Tuscaloosa Mining and Manufacturing Company. Whilst this section may be faulty in some particulars, it is probably, upon the whole, approximately correct.

Section of the Coal-Measures in Township 20, Ranges 7 and 8, Tuscaloosa County.

Surface Rocks	40 to 100	feet.	
Coal. Cleveland bed (?)	2 " 4	inches.	
Sandstones, &c.	40 " 0	"	
Coal. (Jones', Harts', Burchfield No. 3.)	3 to 3 " 8	"	
Measures	20 " 0	"	
Coal. (Peterson's and Burchfield No. 2.)	2 " 4	"	
Measures	25 " 0	"	
Coal. (Thomas' 2 ft. 9 in. Burchfield No. 1, Haldman,	6 " 6	"	
Shales	15 " 0	"	
Coal	0 " 2-4	"	
Measures (estimated)	30 " 0	"	
Exposed on Brushy Creek. Coal	0 "10	"	
Sandstones, &c.	150 " 0	"	
Coal	0 " 3	"	
Measures	10 " 0	"	
Coal	0 "10	"	
Sandstones, &c.	100(?) " 0	"	
Coal	0 " 4	"	
Water level Warrior River.			

On the opposite (west) side of the Warrior, there have been fewer explorations for coal, and less is known about that part of the county.

North River and the Warrior, for fifteen or twenty miles before their confluence, flow approximately parallel to each other, the two rivers being separated by a ridge of denudation, the summit of which is more than 300 feet above the water level at the point where the two come together. This dividing ridge has a capping of pebbles and sand 25–30 feet or more in thickness, belonging to the Stratified Drift.

These beds can be traced along the Watermelon, Crabb, and Cheatham roads beyond Wyndham Springs on into Fayette county.

The pebbles are more abundant south of Wyndham Springs. North of that point sand beds prevail, and most of the higher hills are strewn with fragments of ferruginous sandstone near their summits.

Near the sources of Turkey Creek, in S. 9, T. 19, R. 9, W., is a coal seam in two benches separated by shale. The upper bench shaly, of no value, about 10 inches thick; the lower, 20–22 inches thick and of very good quality; it has been used in the forges of the vicinity.

In S. 28, T. 18, R. 9, W., a coal seam is exposed on a branch which crosses the Winton Dunn Road. The coal is about 10 inches thick and lies underneath a bed of shales.

The water of the Wyndham Springs, (NE $\frac{1}{4}$ of S. 8, T. 18, R. 9, W.,) is a pleasant sulphur water, which has its source probably in pyritous shales of the Coal-Measures. The springs are in a slight depression, surrounded by low hills formed of sandstones. The surroundings are pleasant, and this ought to be a favorite summer resort. For those who prefer chalybeate water, a fine cold spring of this character is at a convenient distance from Wyndham Springs, at Mr. W. Hagler's.

A seam of coal, thickness not known, is exposed in the water courses near Wyndham's. This coal has been worked on a small scale to supply the forges.

Beyond the Springs the Cheatham road follows nearly the water shed between North River and the Warrior, to the Fayette County line.

Upon this dividing ridge few rocks are seen, except the sand beds, with occasionally small beds of pebbles of the Drift formation. The timber is red, white, post, Spanish and chestnut oaks, a few short-leaf pines, some hickory and chestnut, black gum and tulip tree (poplar). This growth would indicate a good soil—and such it is, so far as fertility is concerned, but the slight depth of the shales below the surface renders the soil quite liable to suffer from drouth.

The thickness of the Stratified Drift beds over the Coal-Measures diminishes gradually as we go northward, though occasionally very heavy beds of white sand are encountered. The pebbles near the northern limit of the county are not numerous and are quite small as compared with those seen nearer the Warrior.

CHAPTER V.

WALKER COUNTY.

Topography.

In the northwestern corner of this county there is a high ridge capped with gravel and sand. This ridge is a water shed throughout its entire length in Winston, Walker, Fayette, and Tuscaloosa counties. From its position in Walker county, and from its general trend in this and other counties, from northeast to southwest, it will be seen that all the streams of Walker county flow southeast and empty into the Warrior or its tributaries.

Near the dividing ridge just spoken of, the land is high and not very much broken, but nearer the mouths of the various creeks which flow into the Warrior, denudation has produced an extremely rugged country, with high steep hills and deep ravines between. The Sipsey Fork and Mulberry river come together to form the Big Warrior and that with the Little Warrior or Locust Fork, forms the main river. Between the Mulberry Fork or Big Warrior and the Locust Fork, or Little Warrior, there is a dividing ridge or water shed, which makes the southeastern boundary of the county. This is a true ridge of elevation, and is the prolongation of the anticlinal fold of Brown's valley. It diminishes in height very gradually in going southwestward from Reid's gap in Blount county, where it is some 450 feet elevated above the water level in the Mulberry river at Hanby's mill. In the lower (southwestern) portion of the ridge, the height is some 200 or 250 feet above the level of the river, and this is the general height of the hills on the western side of the river. Besides the Sipsey, the principal creeks of the county, are Blackwater, Cane, Lost, and Wolf creeks.

in reddish sandy clays, but usually the pebbles are found in tolerably thick beds, the lines of stratification of which are, however, very irregular. Most of the drift materials are highly colored, red, orange, and yellow with hydrated ferric oxide.

The Drift sometimes mingles with the soils formed from underlying rocks; but it is often found in beds of great thickness in this part of the country, usually covering the hill tops; the present heights of many of the hills in the northwestern corner of Walker county, are owing to a protecting cap of ferruginous Drift sandstone which has resisted denudation.

DETAILS.

1. *Coal-Measures.*—The dividing ridge between Walker and Jefferson counties and between the Mulberry and Locust Forks of the Warrior is, as has been already stated, the continuation of the Brown's valley anticlinal. From Reid's gap, which is the southwestern end of the *denuded* portion of the great anticlinal, the fold *(unbroken)* continues southwestward with gradually diminishing height till it sinks to the general level of the country near the confluence of the two forks of the Warrior.

From these circumstances it will be seen that along part at least of this ridge, the (geologically) oldest rocks of Walker county are to be found as surface rocks. From the crest of the fold towards Reid's gap, most of the softer sandstones and shales of the Coal-Measures have been removed by denudation, leaving exposed the hard quartzose sandstones which are generally found near the base of the Coal-Measures. The lowest of these rocks has often received the name of the Millstone grit, and it may be seen in the *broken* fold on each side of the valley at Reid's gap, and upon the *unbroken* part just southwest of Reid's gap, from which point it may be traced as a surface rock some miles southwestward. Standing upon this ridge near Reid's gap, one can see plainly the two coal basins, one towards the northwest drained by the Mulberry, the other southeast, drained by the Locust fork of the Warrior.

From this ridge the strata sink away rapidly on each side, and within three or four miles of its crest, the coal beds of the overlying strata are exposed in the rivers and along the banks of the other streams.

As yet, sufficient data are not at hand to enable me to give even an approximately full and accurate description of the Coal-Measures in Walker county, and I can only speak of the outcrops of coal where they have been observed, and give the thickness of the beds where it is possible. In those places where coal has been worked a few years, or perhaps only a few months ago, the exposures have been hidden by the washings of sand, &c., over them, so that only in the fewest instances has it been possible to measure actually the coal beds. Generally I can give only the reported thickness.

On the road from Tuscaloosa to Jasper, near the northwest corner of T. 16, R. 9, W., outcroppings of coal may be seen in the bed of Wolf creek and along the little branches flowing into it. The thickness of the bed could not be measured. At this point the bottom of Wolf creek is about one mile wide and quite fertile. The main objection to it for agricultural purposes, is its liability to be overflowed every year. There is a descent of about 400 feet from the surrounding hills into the creek bottom.

Across Cane creek, coal is again seen about 75-100 feet above the level of the creek.

Between Cane and Lost creeks an occasional small patch of pebbles of the Drift is seen, and pebbles also occur along the immediate banks of Lost creek. Beyond this point towards Jasper, pebbles and sands are seldom seen.

Coal is reported as occurring in the bed of Lost creek, near the crossing of this road. Its outcrop I did not see; but about 150 feet above the water level is a coal bed, which measures fifteen inches at its outcrop near the road. From this, however, no correct idea can be had of the actual thickness of the bed, since the outcrop was partially hidden in a mass of decomposing shales.

About four miles from Jasper another outcrop of coal was

noticed; height about 75 feet above Jasper, and in the edge of the town, a bed which is exposed in most of the branches in the vicinity. The thickness of this bed is something over one foot, but it was not possible to get a good exposure.

At several points near Jasper, there are springs breaking up through the carboniferous slates, the waters of which are slightly impregnated with sulphuretted hydrogen. Several springs of this sort occur about 2½ miles southwest of the town, and one is near the northern edge of the place. A fine chalybeate spring is upon the place of Mr. Stovall, in the town.

On the Jasper and Elyton road, near the crossing of Cane or Coal creek, are several outcroppings of good hard coal, three feet in thickness.

At Davis' Ferry, coal, reported to be three feet thick, is reached at a depth of ten feet below the surface; coal is also found in the river close by, possibly the same bed.

Southeast of the ferry, an outcrop of coal is shown by the road near Section 17 or 18, T. 15, R. 5, W. Between Jasper and the river, near the 15 mile post, coal is seen at approximately the same level as the outcrop above given; but as the strata show occasionally decided undulations, one cannot say that the two outcrops are of the same bed of coal.

Near Davis' Ferry, the hills have a general elevation above the river level of 150 to 200 feet, and near the river the country is very much cut up by the water courses. In a few places, hills occur, 400 feet elevated above the river. Jasper, by aneroid observations, is about 100 feet above the river level at Davis' Ferry.

In the southeastern part of the county, near the line of Jefferson, and upon the flank of the dividing ridge above mentioned, are three small seams of coal, one of which has been worked to supply a local demand. These three seams have about the relation to each other as below given:

Coal, thin seam	6	to	8	in.
Sandstones, shales, &c	50	feet	0	"
Coal, thin seam	0	"	6	"
Sandstones, &c	30	"	0	"
Coal	1	"	0	"

From their position with regard to the anticlinal ridge, it is probable that these are some of the lowest seams in Walker county; yet the want of accurate surveys makes this merely an opinion.

On the Old Baltimore road, just at the crossing of Blackwater Creek, and near the mouth of the same, coal is seen by the road, apparently the outcrop of a tolerably thick bed.

On the Jasper and Warrior Station road, the river is crossed at Sanders' Ferry, on the line between the northeast and northwest quarters of S. 26, T. 14, R. 6, W. At the mouth of a branch just below the ferry, and near the water level in the river, a bed of coal is known, of tolerably good quality and at least eighteen inches in thickness. Going up the hill to Mr. Sanders' house, another outcrop of coal is seen.

Near the bend in the river, in the southwest corner of S. 28, T. 14, R. 5, W., is the old Phillips and Camak mine. At present the pits are all filled with water and rubbish, so that no coal exposure was seen. From 'Squire Phillips, who raised many boat-loads of the coal, and floated it down to Mobile, I have obtained the following notes concerning this mine: The bed averages 24–28 inches in thickness where mined; the coal was all taken from the bed of the creek about $\frac{1}{2}$–$\frac{3}{4}$ mile from the river; between the mine and the river outcrops of coal may be seen all along the banks of the creek; the river must rise 15 or 20 feet before the water backs up into the mine; coal has also been raised from the bed of the river, just below the mouth of the creek. From the above, it seems either that the coal bed dips northwest down the creek towards the river, or that there are several distinct benches of coal in the seam; and, from the fact that coal has been raised from the bed of the river here, there is very little doubt that there are at least two distinct beds, within a vertical distance of 25 or 30 feet.

Near the main road, some distance above the Phillips and Camak bed, another coal seam is exposed, perhaps the same

as that mentioned as showing on the hill-side near Mr. Sanders'. Further on near Democrat, near S. 34, T. 14, R. 5, W., coal shows again.

Old Town, or Old Warrior Town, is at the junction of the Sipsey and Mulberry forks of the Warrior, and, like most of the old Indian towns, is beautifully situated upon a bluff overlooking the country for several miles towards the north. On the north side, about one and a half miles from the river, coal is reported as being abundant, probably the same seam as that worked at the Phillips and Camak mine.

Along the banks of the Mulberry, from the Gap at 'Squire Gravelee's, S. 34, T. 13, R. 5, W., for several miles eastward, there is a bluff some 200 feet above the river bottom, and from one-half to one mile distant from the river. About 25 feet above the river level, there is a coal outcrop along the road. This bed has been worked in many places, and yields coal of very good quality.

This road, skirting the foot of sandstone cliffs some 200 feet in height, with the fertile bottom of the Mulberry to the south, affords many beautiful scenes.

A short distance from the Walker county line, in Blount county, near Arkadelphia, which is in the southwest corner of S. 16, T. 13, R. 4, W., several occurrences of coal are known, viz.: Three miles west of the town, some distance up the hill, a bed $2\frac{1}{2}$–3 feet thick has been much worked, and the coal is considered good by the blacksmiths. This may be the same seam as that near 'Squire Gravelee's, although it is probably a higher one. About one mile east of Arkadelphia there is a thin seam 6–8 inches. From the bed of the river at Rutherford's ford, about S. 23, T. 13, R. 4, W., and about one and a half miles due northeast from Arkadelphia, large quantities of coal of superior quality have been raised. The thickness of this seam is not definitely known, but blocks of coal of one foot dimensions are common.

From these notes, we may infer that near Arkadelphia, in Blount, and the adjoining localities in Walker county, there are known at least three seams of coal, two of which are

workable, and yield very good coal. If, as is probable, the seam near 'Squire Gravelee's, and that near Arkadelphia, are distinct, there are three workable beds.

The sandstones in the vicinity of Jasper show false bedding—*e. g.*, north of the town where the road crosses the branch near Maj. Long's sulphur spring, the sandstone in the road appears, from this cause, to dip strongly southward or southeastward. The same false-bedded sandstones may be seen all down the branch to where the Jasper and Warrior Station road crosses it, in the eastern part of town. In many places the false bedding has more the appearance of being regular stratification planes, and it is only where heavy beds with cross lines of false bedding are superposed upon each other that the true character of the inclined strata is made apparent.

About six miles north of Jasper, is the town of South Lowell, in the SW. corner of S. 15, and the SE. corner of S. 16, T. 13, R. 7, by aneroid observation 160 above Jasper. The country between is, for the greater part, a moderately level pine woods. The Coal-Measures sandstones lie near the surface in part at least of this belt of long leaf pines. North of Lowell, on the Houston road, an elevation is reached of 300 feet above Jasper. Mt. Zion church is upon this high land, which is a dividing ridge between Blackwater and Clear creeks. In the vicinity of Lowell several coal openings are known, viz., in Rockbridge creek, one mile east of South Lowell, a bed, thickness not known; four miles west of South Lowell, on Charlie creek, a bed, thickness reported to be two feet; also in all this vicinity outcrops of the coal are numerous; this is in or near S. 13, T. 13, R. 8, W. Above the last named locality on Wilson's farm, seven miles west of South Lowell, a bed of excellent coal has been worked, and the coal used in shops. It is highly praised by the blacksmiths.

On the Jasper and Fayette C. H. road, about seven miles from the former place, and in the S. half of the SW. ¼, of S. 34, T. 13, R. 8, W., a bed of coal called the Townley bed, is exposed in the bluff of a small branch. This is one of the thickest seams known in Walker county.

This bed was thoroughly examined and accurately measured, with the following result:

Section of Townley Coal Bed.

Roof, yellowish slaty sandstones, with clay slate below.

(3.) COAL, bony above, consisting of layers of bony coal alternating with thin seams of hard, bright shining coal. The lower part (12 inches) of this coal is better, with less bony coal, and with thick partings of mineral charcoal..... 4 ft. 0 in.

Hard clay slate with fossils..... 0 " 10 "

(2.) COAL, good, hard and bright, free from slate and bony coal..... 2 " 0 "

(1.) COAL, somewhat bony, but good, breaking into small cubes ½ to ¼ inch in size..... 1 " 3 "

Black slate with fossil plants.....

Into this hard slate bottom the cut was made about six inches. Coal from bed No. 2, is that which has been principally used by the blacksmiths of the vicinity, and it has a good reputation.

This bed is seen in several places in the vicinity, and has been worked on a small scale.

The exposure of this bed being in the bluff of a small branch, and being nearly all above water level, shows a rather imposing thickness of seven or eight feet in some places, thinning down however considerably within a short distance, and as the miners have only gotten out the coal of bed No. 2, without exploring below it, the most conflicting statements have been made concerning the bed.

Of the seven feet of coal only half, or perhaps less than half, would pay to mine; the clay slate parting separates the bed into two benches, of which the lower carries the best coal.

The following analyses, by Mr. Henry McCalley, of coal from strata Nos. 1 and 2, and No. 3, of the above section, will show the character of the coal here exposed.

Analysis of Coal from below the clay slate thickness three feet three inches. Locality, Townley bed, Walker county.

Specific Gravity	1.31
Sulphur	0.71
Moisture	3.007
Volatile matter	29.084
Fixed Carbon	63.352
Ash	4.557
	100.00

Analysis of Coal from above the clay slate. Coal somewhat bony, with iron pyrites. Thickness, about four feet. Locality, Townley bed, Walker county.

Specific Gravity	1.45
Sulphur	1.744
Moisture	2.96
Volatile matter	26.162
Fixed Carbon	44.516
Ash	26.362
	100.000

From the analyses it will be seen that the upper bench is shaly or bony, and inferior to the lower, which is a good coal.

Further west, on the same road and about three miles from Eldridge P. O., is the Jaggers bed, which shows some points of resemblance to the bed just described. It is seen along the banks and in the bed of Jagger's Creek, in Sections 11 and 12, T. 13, Range 10, West. The school house is near the best exposure: this is in the SW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of S. 11. For about two miles down the branch from this point, the coal may be seen. The bed, whilst apparently nearly horizontal as a whole, undulates very considerably, for just

above the school house the top of the coal is near the water level; a few rods below the school house, at one point, the entire thickness of the bed may be seen above the water, the bed of the branch being the underlying sandstone; from this point the coal sinks again down stream, so that a few yards from the ford only a foot or two of the upper part of the bed lies above the water, whilst the bed of the branch is a sheet of coal. At the point where the whole bed lies above water level, I made a careful measurement, with the following result:

Section of Jagger's Coal Bed.

Roof—Slaty sandstone, with fire clay below.

Very shaly coal, or rather a bituminous shale	0	feet	7	inches.
Shale, whitish on exposed surface	0	"	7	"
Coal, very bony	0	"	10	"
Coal, very good, but still somewhat bony	0	"	6	"
Coal, good, bright, with thick seams of mineral charcoal—some pyrites	2	"	8	"
Bony Coal	0	"	1-2	"

Sandstone bottom, forming here the bed of the branch, but soon sinking below the water level.

The bed has been examined by means of drills, by a company from Columbus, Mississippi, both above and below the point where the foregoing section was made, and the thickness reported to be about four feet.

Mr. Henry McCalley, in the Laboratory of the Survey, has analyzed two samples of coal from this bed. These analyses will show the general character of the shaly portions and of the better portions of the bed.

Analysis of Coal from Jagger's Bed, Walker county.

Coal consists of alternating layers, about one-eighth inch in thickness, of bright, hard, bony coal, breaking into cubes, and of duller, softer coal. It contains also thin seams of mineral charcoal.

Specific Gravity	1.44
Sulphur	0.36

Moisture	2.238
Volatile matter	29.037
Fixed Carbon	50.638
Ash	17.987
	100.000

Analysis of Coal from Jagger's Bed.

A firm coal, smutting but little, breaking into cubes, and consisting of alternating layers of bright, hard coal, and duller, softer coal, with an occasional thin seam of mineral charcoal.

Specific Gravity	1.233
Sulphur	.574
Moisture	3.091
Volatile matter	29.044
Fixed Carbon	56.537
Ash	11.328
	100.000

At the ford by the school house coal forms the bed of the branch, and this continues to be the case for half a mile down to Mr. Brown's field, where the underlying sandstone rises to the surface. The sandstone comes to the surface again at another ford two miles below, the coal showing along the banks, at intervals between these two points. By this it will be seen that the rocks are undulating and the coal rises above the water level, or sinks below it two or three times between its upper and lower outcrops. Below the lower ford, begins a tolerably rapid fall, which continues down to the confluence of Jaggers' with Mill Creek, in southwest corner of S. 6, T. 13, R. 9, W. The difference in level between the coal at the lower ford, and the waters of Mill Creek, is about 60 feet, and the distance, following the windings of the creek, about one mile. Near the mouth of Jaggers' Creek the ravine widens out considerably, the high bluffs of sandstone on the two sides being several hundred yards apart. The bed of Jaggers' Creek or branch is filled with huge blocks of sandstone which have rolled down from the sides. In

some places the rocks form overhanging ledges of great size; one, which was examined particularly, has a height of 30 feet or more from the under side of the overhanging rock down to the floor, and the depth of the partial cave thus formed, was about 25 feet. Such places are called "Rock Houses," and they are certainly of great interest to a botanist, for againgt the damp, cool faces of the rocks, grow many varieties of beautiful ferns, and some rare ones, such as Asplenium montanum, Asplenium pinnatifidum, Trichomanes radicans, and Trichomanes Petersii. Besides the ferns, green masses of liverworts cover those parts of the rocks which are constantly kept moist by the dripping of water from overhead.

In the bed of Mill Creek, just below the confluence of Jaggers' branch, is a bed of coal which has been worked. By barometric measurement, the vertical distance between this and the Jaggers' coal bed, can not be less than 60 feet.

Jaggers' branch was closely examined to ascertain whether any other coal bed could be found between the Jaggers' and that in the bed of Mill Creek, but with negative results. Farmers living in the vicinity could give me no information concerning any such coal bed.

On the northeast side of Mill Creek, a small branch comes in just above the Jaggers' branch, and half a mile or more up that branch and above falls similar to those just described, coal is known, possibly the same bed that is exposed in Jaggers' branch. Also, north of the school house, coal is exposed in a branch. And in most places in adjoining sections 11, 12, 1, 2, 3, and 10, according to the testimony of the inhabitants, coal may be struck in wells in low places, at depths ranging from 10 to 15 feet, according to locality.

The country where the Jaggers' coal is exposed, is called "flatwoods," meaning merely open, level land, with no considerable elevations and depressions.

There is probably no coal bed in Alabama about which more exaggerated statements have been made, than about the Jaggers bed, and it may be worth while to consider the origin of such statements. It is probable that the undula-

tions in the bed, bringing it above and below the water level several times in a distance of half a mile, have a good deal to do with these misconceptions, for at one place the whole bed shows above the water, and not 20 feet from that point the bed of the branch is a solid sheet of coal. If the rock forming the bed of the branch, where the coal was entirely above the water, were not examined closely and found to be sandstone, it would be quite natural to infer that the thickness of the bed was much greater than it really is. It must be said that the exaggerated statements concerning the great thickness of the Jaggers coal bed were, without exception, heard at a distance from the place, and generally from persons who had either made a cursory examination or obtained their information at second-hand. The farmers who live in the vicinity have a very correct knowledge of the true thickness of the bed, and from none of them did I hear it given at more than four feet. The following named gentlemen living near the coal bed, have placed me under obligations for favors rendered, and from none of these have I heard any exaggerated estimate of the size of the coal seam: David Walden, Thomas Herron, P. G. Tesney and Mr. Gullaher, the present county treasurer of Walker county.

In Section 16, T. 13, Range 10, West, near Mr. P. G. Tesney's, and in Section 9, just north of him, a fine grained, slaty sandstone is found, which has an extended local use as whetstones. These stones occur of all grades of fineness, and they are very much valued wherever they have come into notice. The fragments lying exposed on the surface are generally very hard and by no means so good as those which are freshly quarried. This peculiar rock occurs on the ridges a mile or more from Mr. Tesney's.

Near the Byler Road, coal has been noticed near Kelly's Store, and further south, near the Masonic Lodge, in S. 19, T. 13, R. 10, W. By barometric observation, the coal at Kelly's Store lies some 50–60 feet above the Jaggers, whilst that at the Masonic Lodge is 175 feet above the same. These measurements are, of course, liable to all the uncertainties attending aneroid barometric measurements.

2. *Stratified Drift.*—The Drift becomes important as a surface covering, only in the northwest corner of Walker county, in the vicinity of the Byler Ridge. East of this ridge the pebbles and sand beds become less and less abundant, and after several miles pebbles are rarely seen, whilst the sands may be noticed much further east. Along the Byler Ridge in this and other counties, both north and south, are many thick beds of pebbles alternating with sand.

Between the Jaggers coal bed and Eldridge P. O., pebbles cover most of the elevations, but the beds are not very thick.

The Masonic Lodge in S. 19, T. 13, Range 10, W., is situated upon a high hill of Drift beds. The elevation is some 225 feet above the Jaggers coal bed. This high point, like many others on the Byler road, is due to the protection afforded by a thin stratum of ferruginous sandstone, (sand grains held together by hydrated ferric oxide,) near the top. The Byler road follows, generally, this drift ridge; but, in places, it descends into the underlying Coal-Measures. Below Kelly's Store the old road, now thrown out, follows the ridge, whilst the new road leaves it, descending into the country drained by Box's Creek, &c., and comes upon the main water shed again in Fayette County, in the lower part of T. 14, R. 11, W.

WINSTON COUNTY.

Topography.

It will be seen by the map that the main dividing ridge between the waters of the Warrior and those of the Tombigbee, runs almost north and south the entire length of the county, near its western line. This ridge—the Byler Ridge—in the northwestern part of Winston, also divides the waters of the Warior from those of the Tennessee, for Big Bear Creek, one of the tributaries of the Tennessee, has its source near this ridge.

The greater part of the drainage of the county, therefore, is southeast into the Warrior, the principal streams being the Blackwater Creek and the Sipsey fork of the Warrior, with its tributaries, Clear Creek, Brushy Fork, and Rock Creek.

On the western side of the Byler Ridge are the sources of the Buttahatchee and New river, which flow into the Tombigbee, and Big Bear Creek, a tributary of the Tennessee.

Although there are in this county no ridges except those formed by denudation, there is a gradual increase in the height of the land going northward from the Warrior river through Walker and Winston, into the southern part of Lawrence county, where the southern boundary of the Tennessee valley and the northern boundary of the Warrior field are formed by *Sand Mountain*. The general *fact* of such an increase in height may be seen by the subjoined figures, obtained by barometric observations from the Warrior river through Walker county into Winston.

It was impossible to get a more complete series of observations at the time of my visit.

With the Warrior River at Davis' Ferry as a datum, the following are the heights above that point:

Jasper	100 feet.
South Lowell	260 "
Mount Zion Church	400 "

Beyond this there is a gradual elevation of the land, the crest of the mountain overlooking the Tennessee Valley in Lawrence county being the highest point. The basin shape of the entire Warrior field from this mountain on the north, to the ridge which is the prolongation of the Brown's Valley anticlinal on the south, may be well made out when the country is seen from a height. The barometric readings above given, whilst they show the increase in height of land going northward, cannot, of course, be relied upon as giving the exact difference in level.

The face of the country throughout Winston county is generally much broken; the map will show the great number of small streams which rise in the northern and western part of the county, and which, by their confluence, form the three or four principal streams mentioned above. From the character of the rocks underlying the greater part of the county, viz.: sandstones and the frequent occurrence of deep ravines, with steep, sometimes precipitous sides, will be explained. The soils resulting from the disintegration of such rocks are never very fertile, and upon the ridges between the water courses, houses are not very common, the farming lands being usually down in the more fertile bottoms of the branches and creeks. Generally the principal growth upon the ridges is a mixture of post, white, red, and Spanish oaks, chestnut, sour gum, and, in some places, short leaf pines.

Wherever the sandstones lie near the surface, the so-called "rock houses" are formed, which are so numerous in this county. At the head of nearly every ravine may be found a crescent-shaped ledge of sandstone, with convex side up stream; the action of running water during rainy weather, and of the spring water flowing out from beneath the majority of these ledges, have the effect of washing out the softer slates and undermining the harder sandstone rocks. In this way, hollow crescent-shaped spaces are produced under a projecting sandstone ledge, and in the rock houses thus

formed, the walls of which are kept constantly moist from dripping water, flourish such ferns as Asplenium pinnatifidum, Aspl. montanum, Aspl. ruta-muraria, Trichomanes radicans, and Tr. Petersii. The last named species was discovered by Judge Thos. M. Peters, of Moulton, in the rock houses of some of the head waters of the Sipsey Fork of the Warrior.

The occurrence of these rock houses at the head of ravines in which there is no running water during the greater part of the year, is not uncommon, but springs of delightfully cold water, sometimes strongly impregnated with iron, issue from beneath most of these overhanging ledges.

The denudation caused by the waters of the creeks, gives to Winston county its reputation for wild and beautiful scenery. Many of the creeks have cut deep gorges in the hard sandstones and conglomerate of the Coal-Measures, and in some instances rapids and water falls have been formed. The most noted of these are the Clear Creek Falls, of which further description will be given below.

Geological Formations.

The formations represented in this county are the *Coal-Measures* and the *Stratified Drift*. The rocks here are like those of the same formations in the other counties above, and need no further description. In the general account of the Warrior Field, it was stated that the Plateau or Table land extended as far southwest as Winston county. The conglomerates and heavy-bedded sandstones which are near the base of the Coal-Measures, form the surface rocks over a good part of Winston county, as far west as the water shed between Sipsey and Clear Creeks.

The sandstones are sometimes uncovered by soil over considerable areas called "Rocky Plains." Through these rocks many of the streams have cut deep gorges, and especially is this the case in the southern and eastern part of the county. North and west, nearer the dividing ridge (Byler's), the face of the country is much less deeply marked by denudation.

From the above, it will be seen that the coal beds of the lower part of the series only are found in the eastern part of the county. These beds are not very many in number, and they are separated by many feet of barren rocks. Westward, beds higher in the series come in, and outcrops of coal become more numerous; but all the coal of Winston belongs, probably, near the base of the Coal-Measures.

The strata of the Coal-Measures in Winston have a general slight dip south and west.

DETAILS.

1. *Coal-Measures.*—Upon the Jasper and Houston road, in S. 9, T. 12, R. 7, W., are the Clear Creek Falls. The waters of the creek here pour over two bluffs of conglomerate, some 200 to 300 yards apart, and each about 30 feet high. The heavy bedded sandstone and conglomerate which make the country here, are in many places underlaid with flaggy sandstones, which, being more easily removed, cause the formation of "table rocks," over which the water falls. These shelving rocks sometimes project as much as 10 to 15 feet. Between the two falls, on the right bank of the creek, it is almost impossible to descend to the water's edge, on account of precipitous bluffs; but, with some trouble, one may descend to the water below the lower fall.

These falls rival in beauty many which are annually visited by thousands of tourists. With the opening of this county to the world, by means of railroads, Clear Creek Falls will, without doubt, attract many visitors.

Near the channel of the creek, pebbles occur, possibly from the disintegration of the conglomerate.

In this part of the county, very few reports are heard concerning occurrences of coal.

Near the ford of Sipsey, the banks of the creek are perpendicular ledges of sandstone many feet in height, and at the heads of most of the ravines in the vicinity are "rock houses," such as have been mentioned above.

Houston, the county seat, is in the southwest of southeast of S. 27, T. 10, R. 7, W.

UNIV. OF CALIFORNIA

In the vicinity of Houston are some outcrops of coal, which are mentioned below:

Two miles southwest of Houston, near Sipsey Creek.

Three miles east of Houston, on Brushy Fork.

Also, on Rock Creek, 7 miles east of Houston.

One-fourth of a mile northwest of the town, in a rocky formation called "the Penitentiary," the coal occurs in thin seams, alternating with other rocks.

At the Ford of Brushy Fork, 4 miles east of Houston, is a thin seam. Also at D. M. Hughes', 12 miles southeast of town, coal has been mined on a small scale, and the same may be said of a seam of good coal occurring on the Sipsey, five miles southwest of Houston.

North of Houston, the Moulton road follows generally a ridge to the northern boundary of the county. The prevailing timber in this section is post, white, red, and Spanish oaks, chestnuts, sour gums, and occasionally short leaf pines.

Fragments of ferruginous sandstone similar to that occurring in the Drift deposits, are frequent in this part of the county, particularly covering the hilltops.

Occasionally amongst these fragments, tolerably fair specimens of iron ore (limonite) may be found. The absence of Drift deposits in any considerable quantity here, makes it somewhat doubtful, whether or not the ferruginous rock belongs to that formation.

There is a prevailing belief amongst the inhabitants of the county that silver, lead, and copper are to be found in the Coal-Measures of Winston. The time-honored "Indian story" about mines of silver and lead, may be heard in every township. Fragments of galena or lead ore have frequently been picked up in the wilds of Winston, just as pieces of the same ore may be and often are found in all parts of the Gulf States, viz., as *loose pieces*. There is no *authenticated* account of any metalliferous vein in the county, nor are such veins to be looked for in Coal-Measures, of which the entire county is made up.

In the western part of the county along the Byler road the

height of the ridge diminishes going south, as may be seen by the following aneroid observations, which show, approximately at least, the heights above the R. R. at Courtland:

Littlesville	470 feet.
Near Mr. Farriss', S. 16, T. 12, R. 10, W	430 "
Near lower line of Winston, in S. 28, T. 12, R. 10, W, Walker county	255 "

Near this road on both sides of the ridge, coal outcrops are known to occur in very many places. I subjoin a few localities which can be given with accuracy.

Near Littlesville, or rather about $2\frac{1}{2}$ miles from Stevenson's gap, a bed of coal has been worked.

On Tedford's creek one of the branches of Sipsey, near S. 8, T. 8, R. 9, W.

One mile southeast of Littlesville, a thin seam of slaty coal.

One or two miles west of Littlesville, coal—thickness not known.

Three miles north of Littlesville church, on Bear Creek, is the Joseph South coal bed, said to be between 2 and 3 feet thick.

Near the DeGrafenried old place, east of the Byler road is a thin seam, which has been worked to supply blacksmiths' forges.

South of Littlesville, and beyond the junction of the Columbus road, the Byler road leaves the main ridge, and is in some places nearly impassable. At the heads of ravines on both sides of the road are found as usual, "rock houses" in which grow the luxuriant ferns spoken of above.

Larissa Postoffice is situated upon a hill of sandstone, nearly white in some places. The rock is completely decomposed to some depth, and the sand resulting from this decay, though only slightly coherent, shows plainly the lines of stratification, the false bedding, and other marks of the original sandstone. Similar light colored, incoherent sandstones, have been noticed also in several other localities.

At Mr. West's, S. 16, T. 11, R. 10, W, is a bed of coal two

feet thick; this bed is exposed in several places near his house.

Near Mr. Farriss', S. 16, T. 12, R. 10, W, is coal, thickness not known. Also three miles southwest of Farriss' along Coal Bed branch, and two and one-half miles southeast, coal has been raised in blocks over one foot in thickness.

Not far from Miller's Stand P. O., in S. 33, T. 9, R. 10, W, clay iron stone has been obtained in some quantity.

A specimen of this ore, which, if found in sufficient quantity, may be valuable, has been analyzed by Mr. McCalley.

Analysis of Clay Iron Stone from S. 33, T. 9, R. 10, W, Winston County.

Specific gravity	3.563
Hygroscopic Moisture	.967
Water in Combination	1.437
Siliceous Matter	5.209
Sesquioxide of Iron	7,918
Protoxide of Iron	42.082
Alumina	4.046
Oxide of Manganese	.186
Lime	2.418
Magnesia	3.486
Phosphoric Acid	.341
Sulphur	.317
Carbonic Anhydride	31.908
	100.315
Metallic Iron	35.000
Phosphorus	.149

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2. *Stratified Drift.*—Upon reaching the summit of the mountain at Stevenson's gap, coming from the Tennessee valley, sand and pebble beds of this formation are soon encountered. These beds are somewhat infrequent at first, but going southward they increase in number and thickness. The

pebbles may be seen frequently overlying directly shales of the Coal-Measures, and in gullies good sections of pebbles, sand, and clay showing the irregular stratification which is characteristic of the Drift are not uncommon.

The pebbles are of quartz and rounded, though occasionally mingled with somewhat angular fragments of chert. In this respect, the pebbles differ from those found further west in Marion and Lamar Counties, where the angular chert pebbles are almost exclusively found.

The bed of pebbles which hides the line of junction of the Paleozoic and Cretaceous formations, has sometimes been considered a bed of Cretaceous age. The overlapping of these deposits, however, so far upon the Coal-Measures, as well as in the other direction, upon the lower Cretaceous beds, near Eutaw, and southward over still more recent beds, would point to a more modern age than Cretaceous.

South of the junction of the Columbus road, along what is known as the "Cut-off," pebbles are rarely seen, they come apparently not much further east than the main dividing ridge, for when the main ridge is reached again below the "Cut-off," pebbles are abundant, and they are found thence southward to the Walker county line and beyond, upon all the hill tops.

Upon distillation, it might yield valuable products, such as benzole, &c.

A few miles north of this point, near Jephtha Hollingsworth's place, a coal outcrop may be seen in the road. This bed has been worked. Also four miles from Jacob Hollingsworth's bridge, is a coal bed which has been much worked to supply coal to blacksmiths. Of its thickness I can give no notes. In the same locality is a quarry from which sandstone, splitting into smooth regular slabs, has been obtained in considerable quantity for building purposes.

Along Box's Creek, in T. 14, R. 11, W., are many outcrops of coal; at several of these, the coal has been worked; thus, in the SW $\frac{1}{4}$ of S. 15, in S. 11, and in S. 23. The thickness of the beds, I can not give with certainty, but the average will be about two feet.

In the SE corner of S. 24, same township and range, a stratum of bituminous shale (called here cannel-coal,) similar to that mentioned above, overlies a bed of ordinary bituminous coal.

Box's Creek bottom has some of the best farming land in the county. The bottom is nearly one mile wide. The soil seems best adapted to corn, for the cotton usually has too rank a growth and the bolls do not open well, many of the squares and forms drop off quite early.

Near the mouth of Moore's Creek, about S. 7, T. 14, R. 11, W., a ten inch seam of coal is exposed in the bluff of New River, and 15 or 20 feet below the ten inch seam, another two feet thick is found in the bed of the river. Along this creek and on New River, within a radius of 10 miles from Mr. Woodward Moore's, S. 12, T. 11, R. 12, W., are numerous outcrops of coal besides those mentioned.

Mr. Ira Woodward Moore, President of the Alabama Sipsey River Navigation Company, has for some years been interested in a scheme for carrying coal by barges down the river to Mobile. The coal is mined near the southern line of Marion county, and during the high waters of the winter the loaded barges are floated down the river to Mobile, where it can be delivered at $2 per ton. The locality of the mine

and other details concerning the coal, will be given under Marion county.

Along North River and its tributaries, coal is abundant, but I can give now no definite localities.

From the few notes thus given, it will be seen that outcrops of coal are found along all the principal streams of the county, and their tributaries. As to the number of workable seams of coal and their thickness, there is as yet no reliable information. To examine thoroughly one of these counties, and to determine definitely its capabilities for the production of coal, would take months of time and a considerable outlay of money. With the present small appropriation for the survey, the last named item, viz: an outlay of money, is an impossibility.

(2.) *Stratified Drift.*—The beds of this age are of the usual character, rounded pebbles, sand beds, clays (usually colored deep red or orange, by the hydrated oxide of iron), and ferruginous sandstones and conglomerates with the same hydrated ferric oxide as the cementing principle.

Distribution.—The Byler Ridge, which separates the waters of the Warrior from those of the Tombigbee, is near the eastern limit of the pebbles, for beyond that towards Walker county the beds of Drift, which are found sparingly on the higher points, are usually of sand only, or occasionally of small pebbles intermingled with the sands.

The pebbles are usually rounded quartz and chert fragments; the latter show often traces of organisms, usually impressions of crinoidal stems, &c., of Sub-Carboniferous age.

The beds of pebbles, whilst they cease to be a prominent feature of the surface geology of the county east of the Byler Ridge, are found in occasional patches, at least as far eastward as the ridge between Cane and Lost Creeks in Walker county, in T. 15, R. 8, W.

Along the Cheatham road in T. 16, R. 9, W., near Boley Springs P. O., the ridge is covered with beds of sand, with occasionally beds of small pebbles. The thickness of these

beds is considerable, as may be seen in the excavations near the saw mill and tan yard.

Along the Byler road every hill of moderate height is made up, in part at least, of pebbles, and most of them are capped with ferruginous sandstones or conglomerates. Near the Dublin P. O. the hills are covered with fragments of this sandstone, and in the road may be observed hollow pipes or cylinders of this substance lying in a northeast and southwest direction.

South of Mr. William Killingsworth's, S. 14, T. 14, R. 11, W. the hills as usual are capped with pebbles and ferruginous sandstone. The ferruginous rocks seem always to be encountered whenever the hills are as much as 200 feet elevated above the water courses. In T. 15, R. 11, W., the hollow cylinders of ferruginous sandstone lying in a northeast and southwest direction, may be seen again. In fact, wherever I have noticed these elongated forms of the Drift ferruginous sandstone, their longest dimensions point in this direction.

Between the Byler Road and Sipsey or New River, the pebbles are sometimes less abundant, but ferruginous sandstones and conglomerates are found upon every prominent hill. On the left bank of Sipsey, east of Fayette Court House, this conglomerate is found in beds of considerable thickness, making tolerably high bluffs.

The high bluffs which overlook the river on the eastern side, near Ford's bridge, in S. 11, T. 15, R. 12, W., have a capping of this rock many feet in thickness, and the road at the foot of this mountain passes many large fragments which have rolled down from the heights above.

Near New River, on both sides, pebbles are particularly abundant. The road from Fayette Court House up the right bank of the river, is for many miles over beds of this kind, and the road is of the very best character, smooth, hard and moderately level.

In some localities these pebble beds appear to be of exceptional thickness, as near Hollingsworth Mill, New River P. O, McCollom's Mill, &c.

Along the Pikeville road, on the western side of the ridge, between New River and Luxapolila, many of the pebbles are of chert, more or less angular and with impressions of Sub-Carboniferous fossils.

In many places among the Drift beds, are found strings of quartz crystals covering what have the appearance of being fragments of petrified wood; such are found, for instance, seven or eight miles north of the Court House, and two miles west of the town on Judge Williams' farm. At the latter place occurs, also, a peculiar modification of the ferruginous rock which characterizes the Drift. This rock is porous, from the occurrence within it of numerous lenticular or almond shaped concretions of limonite, hollow and enclosing a mass of white micaceous clay or sand. The shells of limonite are generally one or two tenths of an inch in thickness, in some instances double, the two being easily separated from each other. Occasionally the concretionary shells seem to be rather of the composition of turgite than limonite, as shown by the reddish color of the powder. The rock, when first quarried, is soft and easily cut with an axe, but after short exposure to the atmosphere it becomes quite hard and is said to be durable. It is used for rough stone work, in the construction of chimneys, pillars, &c. In this locality the rock is rather of the nature of a bog formation than of the usual ferruginous sandstone of the Drift.

Between the Court House and Luxapolila River, all the hills show a covering of pebbles, and the highest always a capping ferruginous sandstone. West of Luxapolila, on the road to Vernon, pebbles are noticed on all the hills whenever the elevation of 150–175 feet above the water courses is reached; below that elevation the strata are mostly sands and clays; the tops of the highest hills are always covered with fragments of ferruginous sandstone, or ferruginous conglomerate. The formation of these rocks appears to have taken place in this way: the sands, pebbles, &c., of the Drift, strongly colored with hydrated ferric oxide, in contact with atmospheric water, holding carbonic acid and organic matter, are leached of the iron, which in solution penetrates the

more porous strata, and upon reaching an impervious bed, say of clay or similar material, is arrested in its downward progress, gradually indurates from the evaporation or escape of the solvent, and in indurating binds together the sands or pebbles in contact with it. The formation, in this way, of hard ledges in recent railroad cuts, may be noticed frequently wherever the cuts are through beds of Drift sands, &c. The almost universal occurrence of fragments of these rocks upon the highest hills, may easily be explained. The hills of this part of the State are exclusively hills of denudation. After the Drift beds were deposited, there is reason for believing that the general face of the country was much more uniform than it now is. The effect of running water has been to cut up this more or less level country into gullies, ravines and gorges; to widen them out into valleys, leaving between as hills the portions of the original beds which were not so washed down. If any part of the originally nearly level country were soft and easily eroded, there would be formed a depression, which would in time become a valley of greater or less extent according to the amount of water passing over it. If a hard bed of any sort were formed, such as a bed of the ferruginous sandstone produced in the manner indicated above, it would protect the underlying beds of sands, pebbles, or other softer materials, from denudation, and would thus become the cause of the formation of a hill. The gradual undermining of the hard stratum, would cause it to break off, and in this way the sides of the hills for some distance below the protecting bed would be covered with its fragments. Every one familiar with our Drift regions, has noticed these fragments of ferruginous sandstone and conglomerate upon the sides of the hills which owe their existence, or at least their present height, to a protecting cap of this rock.

If the solution of iron formed as above described, from the iron which is diffused as coloring matter through the sands, instead of penetrating the strata and forming a hard-pan by induration, should come to the surface at a lower level, it would appear as a chalybeate spring. The conditions for

such springs are simple; atmospheric waters charged with carbonic acid, and holding organic matter, (by which the peroxide of iron is reduced,) dissolve the iron, penetrate the soil, and come to the surface again at some lower level. In contact with the air the carbonic acid escapes, the iron is changed back into the peroxide, which in the form of a hydrate is precipitated in the spring, or the outlet from the spring, as a flocculent mass of yellowish or reddish color. Several springs of this character are found within a few miles of Fayette Court House.

LAMAR COUNTY.

It is convenient to describe this county in connection with the Warrior Basin, although the Tombigbee, instead of the Warrior, receives its entire drainage.

No Coal-Measures have, so far as known, been observed in Lamar, yet it is probable that in the northwestern part of the county, near Pikeville, rocks of this age are exposed in ravines.

Whether exposed or hidden, there is no doubt that the Coal-Measures underlie the beds of Stratified Drift in that corner of the county, thus connecting Lamar with the great Warrior system.

The general course of all the streams of this county is southwest, and this determines, to a great extent, the configuration of the county. The principal streams are Luxapolila River, in the southern part of the county, Yellow Creek and Hell's Creek and other tributaries; and, in the northwest, Buttahatchee River and Beaver Creek and other tributaries. In the latitude of Vernon, which is situated in S. 16, T. 15, R. 15, W., the hills separating the streams are usually from two hundred to two hundred and fifty feet elevated above these water courses.

The only formation which has come under notice in the limited portion of the county visited, is the *Stratified Drift*. Beds of sand, clay, pebbles, and the rocks formed by the cementing together of the sands and pebbles by hydrated oxide of iron, form the surface covering.

The beds of Drift materials are very heavy, being in the middle and eastern part of the county, at least two hundred and fifty feet in thickness. From Vernon northwards towards Pikeville the pebbles are more or less angular, and of chert usually containing the impressions of Sub-Carbonifer-

ous fossils. With these are also found rounded pebbles of quartz of the usual character.

Between Fayette Court House and Vernon the road passes over all the hills separating the Luxapolila and the several prongs of Hell's Creek. These hills are often two hundred and fifty feet elevated above the water courses, and the upper fifty or seventy-five feet are formed of pebbles and sand; the highest hills being, as usual, covered with fragments of ferruginous sandstone.

Two miles west of Vernon are the ore banks which supplied the blast furnace of Messrs. Hale & Murdock. The ore banks resemble those of the Silurian formation in Middle Alabama, and those of the Sub-Carboniferous formation of Franklin and other counties in North Alabama. A deep red-colored soil holds masses of ore from the size of a bushel measure down to small pebbles. The ore is in concretionary masses like the ore of the two formations mentioned. The ore banks are in hills of moderate size, and are found over territory of considerable extent. In one place, where a gully has formed a natural section, the ore is seen to overly beds of pebbles. The source of the iron in this case is probably the same as that from which is derived the iron disseminated through the sands, &c., of the Drift as coloring matter, viz.: the cherty limestones of the Sub-Carboniferous formation further north. The nearest point where this limestone is known *in outcrop*, is forty miles distant from this ore deposit. It is quite possible, however, that future examinations may show that the limestone exists nearer to the ore hidden by the overlying Drift beds.

Mr. Henry McCalley, in the Laboratory of the Survey, has analyzed three samples of the ore from these banks. The analyses will show the character of the ore:

1. *Analysis of Limonite; an aggregate of nodules; the nodules compact and dark brown in color, held together by red and yellow ochre, with a few empty cavities, both within and between them. Streak, yellowish brown. Locality, site of the old "Hale & Murdock Iron Works," near Vernon, Lamar county.*

Specific gravity	3.421
Hygroscopic Moisture	1.777
Combined Water	12.466
Siliceous Matter	4.371
Sesquioxide of Iron	78.284
Alumina	0.760
Oxide of Manganese	.000
Lime	0.809
Magnesia	0.391
Phosphoric Acid	0.615
Sulphur	0.129
Undetermined and Loss	0.398
	100.00
Metallic Iron	54.80
Phosphorus	0.268

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2. *Analysis of concretionary limonite of uniform texture. Color, dark brown, with spots of red and yellow ochre filling some of the small cavities. Streak, reddish brown. Locality, near Vernon, Lamar county.*

Specific gravity	3.461
Hygroscopic Moisture	1.468
Water in Combination	12.372
Siliceous Matter	4.367
Sesquioxide of Iron	80.053
Alumina	.221
Oxide of Manganese	.188
Lime	.407
Magnesia	.045
Phosphoric Acid	.624

Sulphur	.085
Undetermined and Loss	.170
	100.000
Metallic Iron	56.037
Phosphorus	.272

3. *Analysis of compact limonite, with few irregular cavities; some of the cavities filled with red ochre. Color of fresh surface, dark brown, with the red ochre in spots. Exterior surface, brown, with a slightlg reddish tinge. Streak, reddish brown. Locality, near Vernon, Lamar county.*

Specific gravity	3.392
Hygroscopic Moisture	3.843
Combined Water	8.155
Siliceous Matter	4.506
Sesquioxide of Iron	81.173
Alumina	1.341
Oxide of Manganese	0.073
Lime	0.298
Magnesia	0.032
Phosphoric Acid	0.268
Sulphur	0.138
Undetermined and Loss	0.173
	100.00
Metallic Iron	56.821
Phosphorus	0.117

Northward from Vernon, the road follows a ridge, which is 200 feet above Yellow Creek. Along this road the pebbles are angular fragments of Sub-Carboniferous chert, with many characteristic fossils. These angular pebbles, like the rounded ones, are common in the ferruginous conglomerates which take a prominent place amongst the rocks of the country.

The village of Moscow is 180 feet above Yellow Creek, near Vernon. On the higher points along the road, sand and loam form the surface. The pebbles are not common above the elevation of 175 feet.

Just beyond Moscow, in a gully, is seen the following section through Drift strata:

Pebbles and loam surface	
Yellow sand, reddish below	1 foot 6 in.
White plastic clay	0 " 8 "
Pebbles imbedded in sand	3 " 0 "
Yellow sand, reddish below	1 " 6 "
Yellowish and whitish plastic clay	0 " 8 "
Yellow sand	5 " 0 "
Pebbles imbedded in sand to bottom of gully	2 " 0 "

This section is instructive as illustrating the mode of formation of the common ferruginous sandstone, for just above the two strata of clay, the sands are changed into a reddish sandstone. The iron solution percolating the sands, upon reaching the impervious clay, is arrested, the iron precipitated as hydrated ferric oxide, which binds together the grains of sand, thus forming a moderately hard rock. Another notable circumstance in this section is the regularity in the stratification, the several beds enumerated being parallel, and clearly marked for a distance of fifty yards. Usually, the stratification of the Drift beds is exceedingly irregular.

Beyond Moscow the road is generally a ridge road. On many of the hills, but not on the highest, pebbles are abundant. These pebbles are of chert and angular, and many of them contain casts of Sub-Carboniferous fossils, and these, like the rounded quartz pebbles further south, are often found cemented together by the hydrated ferric oxide into a breccia. These pebble beds are often from ten to twenty feet in thickness.

The relations of the pebble beds to the other Drift strata may best be seen from the following notes: At Purnell's Mill, NE. corner of S. 14, T. 15, R. 15, W., on the north bank of Beaver Creek, as well as on the opposite side of the creek bottom, the low hills are made up of angular pebbles of

chert with Sub-Carboniferous fossils, and with these occasionally rounded, smooth, pebbles of quartz, jasper, &c. This association of angular chert pebbles, with those of the harder quartz, perfectly rounded and smooth, would show apparently that the quartz pebbles have been brought from a greater distance than those of chert. I have noticed both kinds of pebbles in nearly all the pebbly hills in Lamar, Marion, and Franklin Counties.

Beyond this mill, the road gradually ascends to a ridge, the water shed between Beaver Creek and Buttahatchee River, the average height of which above the water courses is 175 to 180 feet. No pebbles are found at this elevation, but lower down, within 50 feet of Beaver Creek and other streams, they are abundant. Towards Pikeville the ridge upon which runs the Military road, increases in elevation, the town being by aneroid observations 250 to 300 feet elevated above the level of Yellow Creek at Vernon.

MARION COUNTY.

Topography.

An examination of the map will show that the ar drained by the Buttahatchee river and its tributaries i cludes the greater part of the county. Subordinated to th are the areas drained by New River and Luxapolila in t southeast, by Bull Mountain creek in the northwest, and b Big Bear creek in the northeast part of the county. Th head waters of Buttahatchee River flow from near the Byl ridge in Winston county. The general direction of th stream is westward for eighteen or twenty miles, and the southwestward into the Tombigbee. Most of the tributarie of Buttahatchee flow southward into that river from the hig ridge of pebbles, etc., which turns Big Bear creek north wards. Bull Mountain creek also flows from the south sid of this ridge, whilst Big Bear creek, rising as it does near th Byler Ridge, flows at first southwest, is deflected by the peb bly ridge spoken of, and is turned thence northwest into the Tennessee. The bed of Big Bear creek is considerably higher than the head waters of Buttahatchee River, and Bull Mountain creek, which are distant from it only a few miles; so that a comparatively short canal cut through the ridge would suffice to turn the waters of Big Bear creek in a torrent into Buttahatchee or Bull Mountain creek,

New River and Luxapolila drain the southeastern part of county, New River having its head waters near the Byler Ridge, whilst the West fork of New River, and Luxapolila, rise at the foot of the ridge separating these from the tributaries of Buttahatchee.

Geological Formations.

In Marion County, we find as surface formations—1st, the *Coal-Measures*, and 2d, the *Stratified Drift.*

Over the entire county there is a superficial covering of pebbles and sand of the Drift age, these beds increasing in thickness from the Byler Ridge on the east, towards the west, where, beyond the Buttahatchee River, they are of such thickness that the streams seldom, if ever, cut through them down to the underlying Coal-Measures. In all the eastern and central portions of the county, however, nearly as far west as the line between Ranges 14 and 15, the streams have cut through these superficial beds, and laid bare the rocks of the Coal-Measures underneath.

Except in the northwestern part of the county the underlying Coal-Measures probably do not extend much further west than the line between Ranges 14 and 15, where there is reason for thinking they are succeeded by the rocks of the Cretaceous System. Still the line of junction of the two is hidden by the immense thickness of pebbles and sand, so that as yet it cannot be laid down with accuracy.

On Prof. Tuomey's map, the area beyond the western line of the Coal-Measures in Marion, is marked as Sub-Carboniferous, whilst according to Prof. Hilgard, of Mississippi, it should be Cretaceous. I have not succeeded in finding west of the Coal-Measures anything except the Drift, until after crossing Big Bear creek in the southwest part of Franklin County, where the Sub-Carboniferous rocks are exposed. For these reasons I have thought it best not to attempt at present to represent the underlying rocks west of the Coal-Measures, but simply to put it all down as Drift, which is actually the surface formation if not of the whole area, at least of all but a few isolated tracts along the banks of the streams. In future editions of the map it may be necessary to make a few slight changes.

DETAILS.

1. Coal-Measures.—The limits towards the west, of the Coal-Measures in Marion County have already been given above in the general description. The coal beds along the head waters of New River or Sipsey, and of Little River, a branch of the Sipsey, are perhaps better known than those of other parts of the county.

Above Kelly's Mill, on New River (S. 10, T. 13, R. 11, W.,) and about one and a half miles from the mill, is the locality from which most of the coal has been mined which has been boated down to Mobile by the Sipsey River Navigation Company. From Mr. Ira Woodward Moore, President of the Company, I have obtained most of the information below given. The bed is said to be 2 feet 6 inches thick. Above this bed, and separated from it by about five feet of strata, is another coal bed two feet thick. The lower bed only has been worked. This coal seems to be an excellent gas coal. Mr. Fish, of the Mobile Gas Works, in a letter to Mr. Moore, gives it much praise. Several miles west of this Mr. Moore mentions an outcrop of what he considers the same bed, on a branch running into Little River. Lower down the river, near the Fayette county line, coal said to be about two feet in thickness is known; it burns well, but is not a very good shop coal. Of the numerous localities where coal shows higher up on New River, I have no reliable information. Upon Little River, near S. 1, T. 12, R. 12, W., are many outcrops of coal.

At Mr. Lem Burnett's, NE. corner of S. 1, coal is raised from the bed of a branch, the thickness of the coal not ascertained. This coal is hard, firm, and bright, tolerably free from pyrites. It has through it seams of mineral charcoal often one-eighth to one-quarter of an inch in thickness. This coal has an excellent reputation amongst the blacksmiths, and it is hauled many miles.

An analysis of this coal made by Mr. Henry McCalley, at the Laboratory of the University, shows the following composition in 100 parts:

Specific Gravity	1.102
Sulphur	1.730
Moisture	3.694
Volatile Combustible Matters	35.380
Fixed Carbon	58.517
Ash	2.409
	100.00

The mineral charcoal, which is so characteristic of some of the coals of Walker, Fayette, and Marion Counties, is of interest.

A specimen of it from coal from Mr. Burnett's bed, upon analysis by Mr. McCalley, shows the following composition:

Specific Gravity	1.551
Moisture	1.753
Volatile Matter	15.285
Fixed Carbon	79.215
Ash	3.747
	100.000

Near Mr. Burnett's, and at a vertical distance of 25 feet above the coal bed just mentioned, is another outcrop in the bluff of a small branch. This outcrop is in the NW. of S. 1, on land belonging to Mr. Beauchamp. The roof is hard shale and floor of the same material; the bed is two feet thick at the outcrop, and, with the exception of an inch or two of slaty coal on top, is good throughout. This coal is also hard, firm and bright, with seams of mineral charcoal like the coal at Burnett's. At the outcrop it shows some pyrites.

In the same neighborhood, on Mr. Shirley's land, coal has been worked. It is like that of Burnett's, and has the best reputation as a shop coal.

At Mr. Hendon's, S. 36, T. 11, R. 12, W., in a well, a bed of coal 18 inches thick was cut at a depth of 8 feet below the surface; below this a clay parting, 18-24 inches thick, and then another bed of coal which was not cut through, the bottom of the well being in the coal. By aneroid observation the following distances have been made out between the coal beds in this vicinity:

Hendon's upper bed	18 inches.
Clay parting	24 "
Hendon's lower bed—thickness not known.	
Sandstones and other Measures (may contain coal)	85 to 90 feet.
Beauchamp's coal	24 inches.
Sandstones, &c.	25 feet.
Burnett's coal—thickness not known, but at least two feet.	

For several miles from Burnett's in almost any direction, coal outcroppings are numerous; amongst these may be mentioned one at Thompson's mine, two or three miles east of Burnett's; this mine is said to yield a good coal, rather harder than any yet mentioned above.

On Clifty Fork, a few miles west of Burnett, is a locality from which coal is hauled for many miles to supply blacksmiths. Accounts of the thickness of the coal on this branch vary. Some give it at two feet, others as much as four feet.

Mr. Purnell, on Beaver creek, who has hauled the coal from this branch to supply his shop, informs me that he has measured the bed and that it is two feet thick, but all good coal. It may be that other beds are exposed on Clifty Fork, the thickness of which may be greater than two feet; thus a bed near Mr. Stephen Vaughan's, S. 23, T. 12, R. 12, W., is reported as being more than three feet thick.

Of coal on Luxapolila River, in Marion county, I can give no localities, nor have I definite notes of any outcrops on Beaver Creek, though the coal is known on both streams.

On Buttahatchee River, three miles west of Pikeville, are reported at least two beds of coal; one six inches thick, and the other of workable size. The coal has been used in blacksmiths shops.

Three miles southwest of R. W. Terrel's, also a bed of coal has been worked on a small scale.

Of outcrops along Buttahatchee and its tributaries above Pikeville, I have no notes except that coal of good quality is known on Barren Creek.

On Big Bear creek and its tributaries, several outcrops are known.

At Allen's Factory, S. 17, T. 9, R. 11, W., the coal has been worked to some extent.

On Bull Mountain creek, near S. 3 or 4, T. 9, R. 14, W., is a bed of coal 18 inches thick, and another near this two feet or more in thickness.

On the same creek, five or six miles below Bull Mountain P. O., coal is said to occur, and this is as far west as I can hear of any outcrops.

On the Hurricane fork of Sipsey creek, or the West fork of Buttahatchee, (as it is also called,) as far down as S. 24, T. 9, R. 15, W., several small seams are reported.

Near Pikeville the sandstones of the Coal-Measures are seen in bluffs on all the little branches. On Raven's-Nest Branch, a mile or two north of Pikeville there are very high bluffs, and some overhanging cliffs or "rock houses." Underneath some of these cliffs grow the most beautiful ferns, such as Trichomanes radicans, Asplenium pinnatifidum, Asplenium montanum, &c. Clusters of the first named fern were noticed with some of the fronds six or eight inches in length.

In some places along this branch, very decided dip 3°–4°, a little west of south, may be observed.

Between Pikeville and the head waters of New River, the sandstones of the Coal-Measures are encountered in all the ravines which are 100 to 125 feet below the level of Pikeville, above that are the pebbles and sands of the Drift.

On the Military road, near the ford across Buttahatchee, the sandstones are exposed at a vertical distance of 275 feet below Pikeville; the ford 280 feet below the same place, is over smooth nearly level sandstones. The bottom of Buttahatchee on the northwest side is one-fourth of a mile wide, and where the road passes the sand is very deep.

Sandstones of the Coal-Measures are reported on Bull Mountain creek, six miles below the Post Office of that name.

2. *Stratified Drift.*—What has been said under Fayette, and especially under Lamar county, concerning the occurrence of the Drift, will apply equally well to Marion.

Near Beaver Creek, and at height of 50 to 75 feet above the level of the creek, the strata are chiefly pebbles; above that height are found reddish sands and clays, with numerous fragments of ferruginous sandstone. On the highest ridges sands prevail, with the dark ash colored soil common on all high black-jack ridges.

East of Pikeville, on the Moulton road, especially not upon the highest points, are numerous pebble beds; the pebbles are angular fragments of chert with casts of Sub-Carboniferous fossils. In the ravines where sandstones of the Coal-Measures are exposed, are pebbles of large size, rounded, and composed of quartz, jasper, etc., with some chert pebbles like those found upon the higher levels.

Thus, near Mr. Lem Burnett's there are such rounded quartz pebbles of large size, four to six inches in diameter occasionally, in the bottoms of the small streams. In S. 6, T. 12, R. 11, W., near the old Van Hoose place, a stream of these pebbles occurs, in which it seems to be established beyond doubt, that gold in small quantity has been found. This gold has, therefore, been transported a great distance, the nearest gold-bearing rocks in the direction from which the pebbles could have come being those of western North Carolina, the pebbles with the gold having probably been brought down the Tennessee valley, and thence southward through Marion and Fayette counties. A few miles north of Fayette Court House is another locality where well confirmed reports are heard of discoveries of gold in a stream of similar large pebbles of quartz, jasper, etc.

Near the corner of Sections 25, 26, 35 and 36, T. 11, R. 12, W., a mile or two from Mr. Burnett's, there is a hill rising some 100–150 feet above the surrounding country. The hill, called Blaylock's Mountain, is entirely made up of materials of Drift age. The mountain owes its present height to a capping of hard ferruginous conglomerate and sandstone, formed in the manner described under Fayette county. These rocks are of dark brownish color, relieved by the light yellow pebbles of chert and sometimes white pebbles of quartz. The conglomerate is hard and massive, showing no tendency to split in one direction more readily than another. From these rocks, especially from the conglomerates, millstones are made for all the surrounding country. Mr. Hendon, who works at the business, has usually more orders than he can fill.

Between Blaylock's Mountain and Pikeville, are several

localities where similar rocks occur, which are, in some instances, worked up into millstones.

A few miles west of Pikeville the same rocks are found. Specimens handed to me by Mr. West are almost identical with those from Blaylock's.

Between Pikeville and Bull Mountain Post Office, the road passes over Drift deposits, except near the ford of Buttahatchee, where the underlying Coal-Measures sandstones are exposed by denudation. At Bull Mountain Creek again, these underlying rocks are exposed. Between these two points the road traverses some high ground, 180 feet above Pikeville, or 450 or 460 feet above the Military ford across Buttahatchie. Beyond Toll-gate P. O. a hill of pebbles of Sub-Carboniferous Chert, 225 feet above the ford, is ascended, and the road continues for some distance along a ridge generally of this elevation. At Mr. J. W. Sanderson's, near the center of S. 22, T. 10, R. 14, W., a well forty feet deep has been dug through the pebbles and water found in the same. Many of the pebbles, which are of chert and somewhat angular, contain casts of Sub-Carboniferous fossils.

Beyond this point, along the New Cut Eastport Road, about 15 miles from Pikeville, the high ridge spoken of above is ascended. Along this ridge, or series of ridges, 180 feet above Pikeville, the road continues for seven miles, till the descent begins into the bottom of Bull Mountain Creek. Upon these high ridges no pebbles are found, nor rocks of any kind, except occasional fragments of ferruginous sandstone. The soil is the light ashy soil mentioned once before. Upon these higher ridges, also, another peculiarity may be observed, viz: the tops of the ridges are usually broad and gently undulating, with no sharp ascents and descents, showing the very slight effects produced by denudation upon this water-shed.

In the descent towards Bull Mountain Creek pebbles may be noticed within 50 feet of the level of the creek, and these continue the rest of the way down the hill. In the bottom of the creek quartz pebbles, well rounded and of large size, like those noticed near Burnett's, are abundant. Here, as

at several other places, pebbles occur of two different kinds: those of chert, and somewhat angular, found more abundantly upon the hills as high as 50–75 feet above the water courses; and large rounded pebbles of quartz, jasper and other similar material, near the beds of streams. With these last are often found, also, the usual chert pebbles mentioned above.

Below Big Bear Creek, *i. e.* towards the south and west, in this county and in Franklin county above, is a ridge of pebbles and other Drift material which has turned the waters of that creek into their present extraordinary course.

As has already been stated, the waters of Big Bear Creek run along a higher level than the streams south, so that a cut through this ridge of pebbles would turn the whole stream south, through Marion county.

Big Bear Creek at Burleson, in Franklin county, is some 75 to 100 feet above Bull Mountain Creek, near the postoffice of that name; but all these levels are given from aneroid observations, and, like all aneroid observations, are not entirely trustworthy; still there is very little doubt that the difference in level between the two points is considerable.

CHAPTER VII.

Chemical Report by Henry McCalley.

Dr. E. A. Smith, State Geologist:

Dear Sir—In accordance with your request, I herewith submit, in a condensed form, some of the methods of analysis, as made by me, and their results. Yours, very truly,

HENRY McCALLEY.

University of Alabama.

Coals.

Proximate Analysis.—Constituents determined: Moisture, Volatile matter, Fixed Carbon, and Ash; and, also, the whole amount of Sulphur.

Moisture.—Determined by loss in weight after a well pulverized sample has been exposed for one hour, in an air bath, to a temperature of 110°C.

Volatile Matter.—Determined by heating the specimen, minus the moisture, in a covered platinum crucible, for four minutes at a red heat and then for four minutes more at a white heat. Loss in weight equal volatile matter.

Fixed Carbon.—Coal, less moisture and volatile matter, is incinerated in a platinum crucible placed aslant, with a piece of platinum foil so resting in its mouth as to reflect back otherwise wasted heat, and to create a current of air over the exposed coal. Loss in weight equal fixed carbon.

Ash.—Residue after incineration equal ash.

Sulphur.—Five parts each of dry, well powdered, carbonate of soda and nitrate of potash are intimately mixed, and then the finely pulverized coal is added, and the whole well mixed. This mixture is now thrown, by small portions, into a white hot platinum crucible with a closely fitting lid. The lid is quickly replaced, and time allowed, after each addition, for quiet fusion. When the whole mixture has thus been added, and time allowed for complete oxidation, the

crucible, with its contents, is allowed to cool. When cold, it is digested with water until complete disintegration; the crucible and lid can then be removed from the casserole. Strong hydrochloric acid is now cautiously added, to excess. This acid can be conveniently added through the beak of a funnel fitting with its rim within the casserole. After excess of acid has been added, it is evaporated to dryness over a water-bath. The dry mass is now digested with a few drops of strong hydrochloric acid. Hot water is now added and the insoluble residue, if any, is separated and washed by decantation and filtration. To the boiling filtrate is now added a slight excess of chloride of barium. The solution is kept hot for some time, when the precipitated sulphate is allowed to settle. The clear supernatant liquid is now decanted off, and the precipitate treated with very dilute hydrochloric acid; after which, it is well washed by decantation and filtration, dried, incinerated, and weighed. This sulphate of baryta, multiplied by .13734, gives the whole of the sulphur present in the coal.

Specific Gravity.—Determined by means of the specific-gravity bottle; the coal having been broken up into lumps of about the size of a pea.

The results of the coal analysis are now appended:

Bituminous Coals.

Proximate Analyses, including Sulphur.

	1.	2	3.	4.	5.	6.	7.	8.
Specific Gravity.....	1.31	1.45	1.44	1.233	1.102	1.551	1.33	1.278
Sulphur...	.71 p'r ct.	1.744 p'r ct.	.36 p'r ct	.574 p'r ct.	1.730 p'r ct.	.....	1.224 p'r ct	.612 p'r ct.
Moisture.....	3.007	2.96	2.238	3.091	3.694	1.753	1.474	1.529
Volatile Matter.....	29.084	26.162	29.037	29.044	35.380	15.285	32.288	30.683
Fixed Carbon.....	63.352	44.516	50.638	56.537	58.517	79.215	59.503	63 686
Ash.....	4.557	26.362	17.987	11.328	2.409	3.747	6.735	4.102
Totals.....	100.000	100.000	100.000	100.000	100 000	100 000	100.000	100.000

No. 1.—From below clay parting; coal firm and lustrous, smutting but little; seam about three feet in thickness. Locality, Townly bed, Walker county.

No. 2.—From above clay parting; a dull, heavy coal; a little shaly, with shining streaks of iron pyrites; seam about four feet in thickness. Locality, Townly bed, Walker county.

No. 3.—From bottom seam, consisting of alternate layers, about one-eighth inch in thickness, of bright, hard coal, breaking into cubes, and of duller, softer coal. It also contained three layers of mineral charcoal. Locality, Jagger bed, Walker county.

No. 4.—A firm coal, smutting but little, breaking into cubes, and consisting of alternate layers of bright, hard coal, and duller, softer coal, with an occasional thin layer of mineral charcoal. Locality, Jagger bed, Walker county.

No. 5.—Firm and almost free from smut, consisting of alternate layers of bright and duller coal, about one-fourth inch in thickness, with a layer of mineral charcoal of same thickness. Locality, Burnett's bed, Marion county.

No. 6.—Mineral charcoal, scraped from sample from Burnett's bed, Marion county.

No. 7.—An average sample, representing the vertical section of the upper bench. Locality, Pratt Coal & Coke Company's seam, near Birmingham, Jefferson county.

No. 8.—An average sample, representing the entire vertical section of the lower bench. Locality, Pratt Coal & Coke Company's mine, near Birmingham, Jefferson county.

Bituminous Shale.

Proximate Analysis—Method same as that of Coals.

Specific gravity	1.099
Sulphur	1.501 per cent.

Moisture	.286
Volatile Matter	75.688
Fixed Carbon	7.284
Ash	16.742
	100.000

A little greasy to the touch, and, in splinters, burning with a very free, luminous, smoky flame, with a strong bituminous smell; color, a dark gray on a fresh surface, but, on weathering, becomes a dirty brown; vein said to be ten inches in thickness. Locality, six miles northwest of Fayette Court House, Fayette county.

SLATE, forming the parting, two inches in thickness, between the upper and lower benches of coal in the Pratt Coal & Coke Company's seam, near Birmingham, Jefferson county.

Proximate Analysis of Slate.

Specific gravity	1.988
Moisture	1.621
Volatile Matter	11.719
Fixed Carbon	23.839
Ash	62.821
	100.000

Ash of Slate.

Silicic Acid	63.155
Iron Sesquioxide	6.383
Alumina	22.884
Lime	.703
Magnesia	.536
Potash	2.164
Soda	1.143
Phosphoric Acid	2.564
Sulphuric Acid	.145
Sulphur Combined	.051
Chlorine	trace
	99.728

The silica, potash, soda, sulphuric acid, sulphur, and chlorine determined according to the method employed by the Geological Survey of Ohio, in report for 1870. The iron determined volumetrically; the phosphoric acid, as under iron ores; and the alumina, by difference, having been thrown down with the peroxide of iron and phosphoric acid, and dried, weighed, and incinerated with them.

IRON ORES.

Methods of Analysis.

Specific Gravity.—Determined by means of specific-gravity-bottle, the ore having been broken up into small lumps.

Hygroscopic Moisture.—An average sample of the finely pulverized ore is weighed and dried at 100°C. Loss in weight equals hygroscopic moisture.

Combined Water.—In case of the pure sesquioxide ores, determined by heating the specimen—minus the hygroscopic moisture—to redness for twenty minutes. Loss in weight equals combined water. In case of the carbonates, or ores containing the protoxide, water was determined by direct weighing. The specimen—minus the hygroscopic moisture—being heated for twenty minutes in the bulb of a hard glass tube, through which a current of dry air was constantly passed; the moisture was collected in a weighed chloride of calcium tube. Increase in weight of the chloride of calcium tube equals the combined water.

Silica, Iron, Alumina, Manganese, Lime, Magnesia, and Sulphur.—The specimen of ore—minus the hygroscopic and combined moisture—is well mixed with a mixture of four parts of carbonate of soda and two of nitrate of potash, and fused, as described above, under the determination of sulphur of the coals. The cooled mass is digested in water, acidified with diluted hydrochloric acid, until complete disintegration, and the crucible and lid can be removed. The solution is now cautiously treated with strong hydrochloric acid to excess, and evaporated to dryness over a water-bath. The dry mass is now digested with a few drops of strong hydrochloric acid, after which hot water is added. The insoluble silica is now separated and washed by decantation and filtration, dried, incinerated, and weighed. The filtrate is diluted to a known bulk, and divided into two parts, one of two-thirds and the other of the remaining third. From the two-third solution the iron is thrown down as sesquioxide with the alumina and phosphoric acid, while excluded from air. The alumina and iron are now separated

by means of hyposulphite of sodium. In the filtrate from the iron, alumina, and phosphoric acid, the manganese is determined as binoxide, by means of bromine. From the filtrate, after separation of manganese, the lime and magnesia are separated and determined after the usual methods. In case any of the protoxide of iron is present, it is determined, as such, by treating a well powdered sample of the ore with strong sulphuric acid, in a flask from which the air is expelled, diluting the solution, and, when perfectly cold, determining the protoxide volumetrically, by means of permanganate of potassium. The sesquioxide present in the ore, as such, can now, of course, be found by subtracting from the whole amount of iron, as found above, the protoxide, as just found. To the remaining one-third solution, heated to boiling, a slight excess of chloride of baryta is added, and the sulphur determined with the precautions stated under coal analyses.

Phosphoric Acid.—A finely pulverized sample of the ore is gently heated with strong hydrochloric acid until the residue looks white, when the solution is diluted and filtered. The filtrate is now treated with ammonia to excess, and then slightly acidified with nitric acid, when it is heated to boiling, and an excess of acid molybdate of ammonia added. The solution is kept near the boiling point as long as a precipitate continues to form. If a precipitate does not form immediately, a little more nitric acid is added, and the solution concentrated by evaporation. The phospho-molybdate of ammonia, thus obtained, is washed well with a dilute solution of acid molybdate of ammonia, dissolved with strong ammonia, and the phosphoric acid determined as pyrophosphate of magnesia.

Carbonic Acid.—Determined, in the usual way, by loss in weight of a suitable apparatus after the gas has been expelled.

The results of the iron ore analyses are now appended in a tabular form:

Bat Guano.

Analysis:—	Moisture	61.016
	Organic matter and combined water	26.473
	Phosphoric acid	2.270
	Sulphuric acid	.217
	Ammonia	.668
	Nitrogen, existing as Uric Acid, etc.	5.798
	Lime	1.524
	Magnesia	.171
	Potash and Soda	1.450
	Insoluble matter, sand, etc.	.336
		99.923

Locality, North Alabama.

APPENDIX.

List of Elevations above Mobile Bay, together with Distances from Memphis of the Stations on the Memphis and Charleston Railroad.

Stevenson,	Ala	271.0	miles	602.80	feet.
Bellefonte,	"	259.0	"	639.19	"
Scott's Mills,	"	254.0	"	651.84	"
Larkin's,	"	247.7	"	620.45	"
Woodville,	"	237.3	"	600.68	"
Paint Rock,	"	232.9	"	595.68	"
Brownsboro,	"	223.3	"	630.76	"
Huntsville,	"	211 6	"	612.14	"
Madison,	"	202 5	"	573.13	"
Moore's,	"	192.5	"	601.32	"
Decatur,	"	188.0	"	572.89	"
Trinity,	"	182.0	"	633.61	"
Hillsboro,	"	176.5	"	598.61	"
Courtland,	"	168.5	"	560.21	"
Jonesboro,	"	163.0	"	560 41	"
Leighton,	"	155.5	"	562.71	"
Tuscumbia,	"	145.0	"	468.25	"
Barton,	"	133.3	"	497.79	"
Dickson,	"	126.6	"	487.71	"
Iuka,	Miss	114.8	"	554.85	"
Burns,	"	107.3	"	463.10	"
Glendale,	"	99.0	"	494.61	"
Corinth,	"	92.8	"	434.12	"
Chawalla,	Tenn	83.7	"	408.61	"
Pocahontas,	"	74.4	"	394.31	"
Middleton,	"	69.3	"	407.13	"
Saulsberry,	"	57.6	"	535.51	"
Grand Junc.,	"	52.0	"	574.91	"
La Grange,	"	49.0	"	530.74	"
Moscow,	"	39.0	"	351.74	"
Lafayette,	"	30.9	"	315.54	"
Collierville,	"	23.8	"	378.54	"
Germantown,	"	14.5	"	377.89	"
Buntyn,	"	5.5	"	303.54	"
Memphis,	"	0.0	"	245.44	"
High water of the Mississippi at Memphis				220.44	"
Low water	"	"	"	170.44	"?

THE END.

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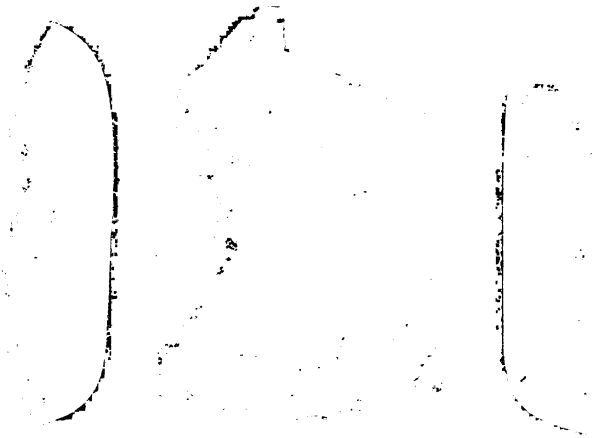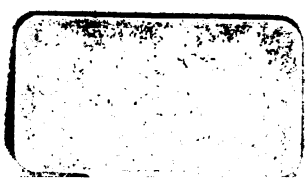
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